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ENGINEERING & MINING JOURNAL-PRESS

A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

How Crude Methods Produced Copper When Other Mines Shut Down

By R. Murray-Hughes

When Will California Reach Its Peak of Oil Production?

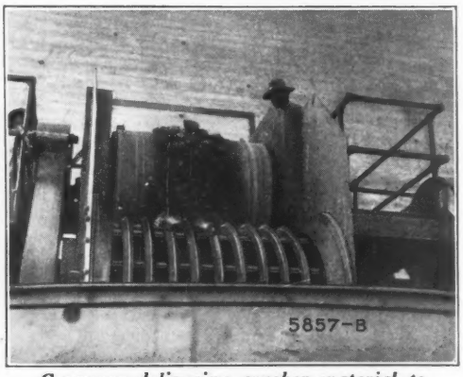
By Joseph Jensen

Charcas, an Ancient District in San Luis Potosi

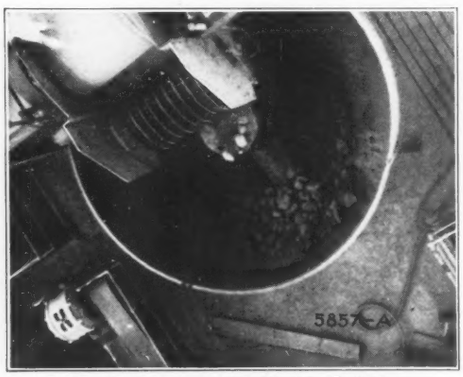
By Charles Leighton Bradbury

Biography of Robert Williams

Hydraulic mining for gold the Nome district, Alas
(See page 103



Conveyor delivering crusher material to Burch Grizzly.



Looking down past Burch Grizzly into crusher

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STEPHENS-ADAMSON MFG. CO.
Aurora, Illinois

BURCH *Grizzly*

ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

Volume 116 | New York, December 15, 1923 | *Number* 24

Facts vs. Illusions in the Copper Industry

WHEN THE PRICES that are obtained for a commodity are too low, agitation for a tariff on that commodity seems to follow as the night the day. A few years ago the farmers thought that they were not getting a fair price for wheat; the tariff was administered as a remedy, despite the fact that the United States has an exportable surplus of that grain. But the price continued to decline just the same, and eventually reached a dollar a bushel at Chicago, which means considerably less than that on the farm. It is close to that figure now.

So far as we in the mining industry are concerned, copper is now the shining example of a commodity that is selling far below the general price level. Based on pre-war conditions, it should sell for 23c. instead of 13c. As is to be expected, the old tariff argument is again cropping up.

The strange thing about the articles that we have read is that no data are given to prove the point; it seems to be assumed that a tariff—5c. a pound seems to be a favorite figure—will immediately boost the price of copper by such an amount as will make its production in this country a much more profitable industry. The statements all emphasize the present unsatisfactory state of the copper industry, suggest the tariff as a remedy, rightly state that the proposed tariff would keep foreign copper out of the country, and finally intimate that with the sixty-odd million pounds monthly of foreign copper kept out of the country, the industry could get along nicely.

We have pointed out the fallacy of this argument before and probably will feel it necessary to do so again many times. In the five months ended Oct. 31 (the November figures are not yet at hand), an average of 63,000,000 lb. of copper per month was imported into this country. About 14,000,000 of this was in the form of ores, concentrates, and matte; 8,000,000 was refined copper; and the remaining 41,000,000 was blister for refining, or its equivalent. During the same period, an average of 69,000,000 lb. of copper per month was exported; practically all of this was in a totally unmanufactured form—bars, cakes, and the like; and most of the remainder was in a partly manufactured form such as rods, wire, and sheets. It may be said here that this exportable surplus is no new condition.

Now, what would happen should a tariff of 5c. per pound or any other supposedly appropriate figure be levied on copper? In all probability, American refiners would merely refine foreign copper in bond, the way Mexican lead is now refined. In other words, the sole effect would likely merely be a little more red tape. The discrepancy would be made up by American copper, and actual imports and exports would not change at all. Or, if this could not be done, we venture to predict that there would be some tall hustling on the part of European copper refiners; it would not be long before their plants would be running to capacity, with enlargements planned. Large foreign producers would seriously consider building their own refineries, as Katanga has already planned to do. For a few months prices might go up in this country, for foreign producers would no doubt temporarily stock their copper rather than pay the duty; then foreign refineries would begin to take it, and American refineries would close down a quarter of their plants. The copper refined abroad would naturally be sold there, displacing an equal amount of American refined copper now sold by the Copper Export Association, the Lewisohns, the representatives of the Nichols Copper Co. and others. A year from now our imports might be 5,000,000 lb. monthly and our exports 10,000,000 lb. Where the advantage?

The only logical argument against our reasoning that we can see is that foreign producers are continually expanding and that this expansion may soon reduce our exportable surplus of copper to a minus quantity. This condition may, of course, arise in the future, and if and when imports show a large excess over exports, the time will then be ripe to at least weigh the merits of a tariff. But now, exports seem to be gaining as fast as imports or faster. In October, for example, exports were 14,000,000 lb. more than imports; and in September, 20,000,000 lb.; both amounts being above the five months' average of 6,000,000 lb.

It may, of course, also be argued that copper sellers here might increase prices without fear that copper might be bought in London, at lower prices, and shipped here. But this is not logical to expect, with the present lack of organization of sellers, for no one would likely be willing to be the goat and market the exportable surplus abroad so long as prices here were higher.

No; there are only two ways to increase the price of copper; either sell more or produce less. As to the first solution, there is little hope of markedly increasing domestic sales through increasing sales effort on the part of producers. We say this with due appreciation of the excellent efforts of the Copper and Brass Research Association, the Anaconda Copper Mining Co., and others, which have helped sales of copper but not to a sufficient extent to cause prices to rise much. The possibilities in foreign markets are better, but there the problem is one of financing and is dependent upon the settlement of international political problems, which has proved a slow process. And with copper at 13c. per pound, and bitter competition, there seems to be no tendency to cut production. Producers who can turn out copper at 10c. per pound or less—and they represent an important tonnage—will rather be inclined to make as much money as possible by working at maximum capacity, thereby also holding down their overhead, and possibly eliminating some competition. Not until copper drops a cent or two more, if that should happen, or until important consolidations are made among producers, is the production likely to be markedly curtailed.

The copper market is a world market. In the last few years immense new deposits have been opened up and few important mines have suspended. These additional sources of supply may well force a new comparative price level for copper below our pre-war conceptions, just as has happened with rubber.

Taxes and Mine Depletion

PROFESSOR HAIG'S article on "Secretary Mellon's Tax Plan and Mine Depletion," in our issue of Dec. 1, aroused considerable interest and comment. Among other things it called forth the following valuable information from McK. W. Kriegh, Chief of the Tax Division of the American Mining Congress:

"In view of the fact that Professor Haig sees in the Mellon program a possible attack on the depletion clause, the article may occasion considerable alarm. It has been learned authoritatively that the paragraph in Secretary Mellon's letter which recommends that deductions for capital losses be restricted to 12½ per cent of the loss, contemplates no change whatever in the depletion clause in Section 214 of the Revenue Act of 1921, but relates solely to Section 206 and to capital gain or capital loss as defined in that section."

Mr. Kriegh adds, however: "Professor Haig's reference to recommendation 10 of the Mellon program shows how carefully he analyzed the situation. If Mr. Mellon's dictum in recommendation 4 had been stated directly in connection with recommendation 10, the inference drawn by Professor Haig could not be denied. Whether or not recommendation 10 and the confidential memorandum submitted therewith involves proposals to amend the depletion clause, cannot be ascertained at this time."

Mine owners will be glad to know that the alterations in the depletion clause in the Revenue Act are not, so far as known, contemplated. Many of the mining industries are far from flourishing, and a reversal of the principle of allowing for depletion of ore reserves would extinguish, in many cases, most of the little net income remaining after the costs are paid.

Capitalizing Society Affiliations

THE VALUE of the bit of pasteboard certifying that John Smith is a member in good standing of the American Society of Slack Wire Walkers or of whatever other scientific or technical organization to which Mr. Smith may belong, depends largely on the degree of sophistication attained by the person to whom he shows it. A union card has real value, and for purposes of impressing the uninitiated the card of any society doubtless has its use. It may even be used to bolster up a stock-selling campaign, as has recently been done in the case of the Burnham Chemical Co., of Reno, Nev. This company's offering of its dollar shares at 25c. each was good until midnight Sept. 20—a bargain evidently, for Mr. George B. Burnham states in his sales letter that they should be worth $12 each with the tons of valuable chemicals that are behind each share. Possibly a few shares remain that can be obtained at the low price quoted. All of our information comes from the company's sales letter, which Mr. Burnham says he dictated while standing by his desk, in a fever of excitement—the excitement of expectancy—waiting to start the construction work and to bring forth the rich yields from the company's vast chemical deposits at its works at Searles dry lake, California.

To strengthen the prospective customer's confidence in the venture and to show his own attainments, Mr. Burnham incloses with the letter a reproduction of his Sigma Xi diploma, California chapter, and of his cards as an associate member of the American Institute of Electrical Engineers and a member of the American Chemical Society. Even though these certificates are honestly obtained, such use made of them is questionable, particularly as the certification implied means little or nothing as to business ability. Possibly in the excitement of his fever Mr. Burnham did not think how he cheapened these organizations and himself by the use he made of their credentials.

"Unlimited Mineral Resources"

AT THE OCTOBER MEETING of the British Columbia division of the Canadian Institute of Mining and Metallurgy, Mr. C. M. Campbell, resident manager of the Granby Consolidated, read a pithy paper on "Publicity and the Mining Industry." Mr. Campbell states that he has been considered a pessimist, but that he still believes that it is neither pessimism nor optimism to look facts in the face. He seems to have an incorrigible tendency to call a spade a spade—neither an implement of agriculture nor a damned old shovel, although possibly his opponents might suspect the latter.

The burden of Mr. Campbell's logic is a protest against the slogan "unlimited mineral resources" for Canada, and the dissemination of the belief that the importance of mining in Canada will be an indefinite crescendo. He has some hard facts to offer to the contrary; and his presentation is garnished with forceful epigrams. He points out that Canada's natural resources, including not only minerals, but timber and other resources, have been and are being consumed at a ruinous pace; and that there will be no adequate future substitute for that which has been thus destroyed.

"Optimism and pessimism," observes Mr. Campbell, "have nothing to do with the matter, any more than that a surveyor should be called an optimist when he marks down 200 ft. as the distance between two hubs when he should have marked down only 100 ft."

Speaking of the transcontinental railways in western Canada, he observes, "Our prophets promised these railways heavy and profitable mining freight. We now refuse to accept responsibility for our statements and say everything will be all right later on. This program cannot be continued indefinitely. We cannot call this a young country forever, and the time has come for a show-down." The growth of manufactures and even of agriculture, he shows, far outstripped that of mining in Canada in the period from 1900 to 1922.

Regarding British Columbia, he writes, "I doubt very much if receipts in mining in British Columbia have balanced expenditures. At any rate, the return to the mining companies on the whole has been far from adequate. In recent years it has been worse than that. In order to pay interest on the cost of an ill-advised railway project, built in the belief in inconceivable wealth, mining companies have been taxed millions by the government. They are paying their taxes, but they are not paying dividends. As a rule they are not and have not since the war. Not only are they not paying dividends, but they are rapidly using up their capital in the shape of ore reserves. It is as if the C. P. R., in order to keep going, had to sell a branch line or two every year."

Concerning the popular cry that more capital is needed for the mining industry, Mr. Campbell is uncompromisingly downright:

"Publicity is periodically given to the statement that what Canada needs is capital to develop its mines. It is not capital that is needed; it is the mines. Even when a mine has been developed there are many instances where too much capital has been expended on it. Capital in the possession of the leading mining companies in particular is systematically hunting for mines in all parts of the world and capital in the possession of men who have made good in other branches of industry is paying the salaries of engineers who are constantly examining properties wherever they can be found. American money, despairing of finding additional orebodies in the United States proper, has poured into South America, Canada and Alaska. Canada has no need to complain of lack of mining capital. Not only has American capital snapped up everything where there was a chance to win, but large quantities of English capital have been placed in Canada, and larger amounts would have been placed had results been more satisfactory."

So much for the claim of the prospector that capital is not available. Concerning the corresponding charge that valuable claims are undeveloped because the owners hold them for an unreasonable price, Mr. Campbell also has plain opinions:

"It is a popular belief that speculators are holding back the mining industry by demanding exorbitant prices for claims, the result being that claims are not developed. There is little or nothing in this belief. A speculator may hold out for a big price for a while, and usually does, or he would not be a speculator. Eventually, however, if the property has merit there will be a deal with somebody, on some basis, or a company will be formed to further develop the property. The industry does not suffer appreciably, for there is only so much ore in a mine anyway, and if it is not taken at first it can usually be taken later. The vast majority of prospects that are lying idle are in that condition because there is nothing about them to warrant further development."

"We are implored," says Mr. Campbell, "to have faith. At Loomis they drove a long tunnel into Palmer Mountain and constructed a huge mill with little but faith to go on. At Keller they equipped a smelter. These schemes have been abandoned. They are in this district, and you are familiar with them. Faith is all right in its place, but it never yet put ore in the ground, and unless you have mineral to go on when working a mining venture you will be discredited." Hush, hush! Mr. Campbell! The chair will call you to order.

Concerning Canada's governmental mineral policy, Mr. Campbell observes, "The faster the extraction proceeds the better the public is pleased. Record extraction is the aim. If we can only 'gut' a mine at a faster rate than it has ever been done before we are indeed proud. This is known as the 'development' of our mineral resources. Possibly 'elimination' will in time be found to be the correct word."

Mr. Campbell advocates a mineral survey in Canada, which will estimate in cold ton-figures the actual ore reserves. This is what we have long advocated for the United States, and with the result that efforts are being made to do this very thing. This work is at present in the hands of committees appointed jointly by the Mining and Metallurgical Society of America and the American Institute of Mining and Metallurgical Engineers.

We have not quoted Mr. Campbell at such length because we wish to discredit the mineral resources of Canada. Indeed, we still firmly believe that the undiscovered metallic resources of Canada, are, area for area, far larger than those remaining in the United States. But many of his views, modified and softened and qualified as you will, are applicable to both countries, and in a way to the world. *There is but one crop of minerals.* It took a billion years to grow this crop, and the harvest that has not already been reaped in the last hundred years of hectic metal mining and consumption will be practically finished in the next one or two or three centuries, leaving the field to the long-drawn-out gleaning which is already all there is left in many of our rich mineral fields. The first thing for a sound financial or governmental mining policy is to be intelligent enough to comprehend facts and honest enough to look these facts in the face.

The Butte-Jardine Mining Co.

IN OUR ISSUE of Nov. 10 we quoted the *New York Tribune's* financial editor and his advice against investing further in a certain mining stock; and we took this as a basis for a few editorial remarks concerning the poor opinion of mining stocks in general held by investors and financial writers, and we urged, as we often have before, a systematic effort toward cleaner promotion and less unscrupulous financing. The honest promoters and the clean operators in the mining industry are, naturally, with us in this desire. The mining industries need capital, but they will get capital soonest by being on a straightforward platform, for nowadays the wise investor tends to become suspicious at the mere mention of "mining stocks."

The *New York Tribune's* letter was apropos of an inquiry concerning stock of the Butte-Jardine mine situated in Park County, Mont., and the answer contained the information that "28,000 shares of this stock had recently been sold at auction in Philadelphia for $50 for the lot." Our comment did not refer to the mine in question, as we had no knowledge of it, but we confined our remarks, as above stated, to an appeal for more conservative financing, so that mining investments would stand better in the eyes of the public.

Recently the secretary of the Butte-Jardine company has written, giving the following explanation to the sale referred to by the *New York Tribune*:

"The 28,000 shares sold for $50 in Philadelphia last June was collateral stock covering a $16,000 note, the owner of which secured title on a judgment, and the transaction was handled at an unannounced sale at the same time that our Treasury stock was being purchased at 50c. per share."

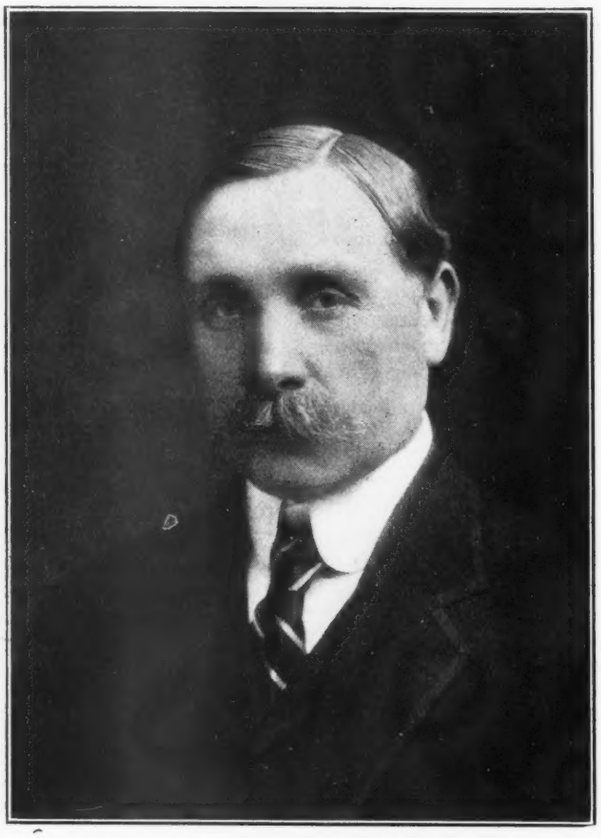
We assume this explanation to be correct. The annual report of the Butte-Jardine Co., for the year ended July 31, 1923, shows a gross profit on ore sales of $32,858, with a net loss on operations of $14,733. Presumably, with the cessation of the Pittman Act, its situation is not so good as last year; hence, we assume, the stock assessment referred to by the *New York Tribune* editor. Certainly, we can support the statement of the Butte-Jardine company that it has a real operating mine and plant. On the other hand, the action of the company on Aug. 13, 1923, in changing its stock from a non-assessable to an assessable basis, does not recommend it greatly to the investor.

Mining Engineers of Note

ROBERT WILLIAMS

By W. A. Doman

ROBERT WILLIAMS, the last of the famous Rhodes band of African pioneers, was born in Aberdeen on Jan. 21, 1860. He received a liberal education in his native town, where he studied engineering. He first went to Africa (Kimberley) in 1881; and, instead of leaving at the end of twelve months, as originally intended, he has devoted his life to the development of the continent. As a keen and energetic young man he was early noticed by Cecil Rhodes, who, in 1891, asked him to report upon the mineral prospects of Rhodesia. Together they formed the Zambesia Exploring Co., to finance the expedition. Williams reported that the minerals were there and suggested, in place of the line from Cape Town, a shorter railway from Beira. In Rhodesia he found Jameson, who, on a bed of sickness, was struggling to keep the country together. Rhodes learned to trust Williams thoroughly, and in 1895 sent him to prospect for minerals in Northern Rhodesia. No immediate success resulted, and in 1898 Rhodes requested him to make another effort to help forward his (Rhode's) railway scheme. Williams went further north, formed the Tanganyika Concessions company, and appointed George Grey leader of an expedition to the border of the Congo State, specifically mentioning for investigation the great divide between the Congo and the Zambesi rivers. The party discovered the Kansanshi copper mine, in Rhodesia, 12 miles south of the Belgian Congo frontier—on the divide! Flushed with the results and with certain deductions in mind, the young engineer applied to King Leopold for a concession in the Belgian Congo. This was granted, a 40 per cent interest in any mineral wealth discovered being reserved for the crown. The king assisted the venture financially. The discovery of the great Katanga copper belt was the outcome. The mineral discoveries of Robert Williams have proved milestones in the progress of African civilization. With an extensive knowledge of mining and metallurgy, he became the recognized authority on these subjects in Central Africa; but he realized that minerals without transport facilities were of little value, and thereupon threw himself wholeheartedly into Rhodes' Cape-to-Cairo railway scheme. Being *persona grata* with King Leopold, owing to his financial and technical ability, he obtained from the king a concession to build a railroad through the Congo; but this was not taken up because Mr. Beit, who was behind Cecil Rhodes, demanded an abnormal share of the mineral rights accruing to Robert Williams and King Leopold. German influences operated against Williams at Brussels, the Colonial Party scheming to secure the Belgian Congo; and a second railway concession proved a failure. To counter this, Williams used his influence in various quarters and gained the right to construct the Benguella railroad from the Congo through Portuguese territory. Fortunately, he outwitted German designs in Central Africa, although he could not prevent Berlin financiers from obtaining control of an English company in East Africa. Under his direction the Union Minière du Haut Katanga, of which he is vice-president, seems likely to become one of the largest copper-producing companies in the world; the output is now over 50,000 tons per annum. Formerly regarded as a visionary, Robert Williams is now cheerfully followed by investors who look forward with optimism to the result of a program of expansion to insure the production of 100,000 tons of copper per annum. He might reasonably be expected to rest on his laurels; but he is full of that Scottish energy that likes "to see results"; and he feels it incumbent to keep his promise to the founder of Rhodesia and devote all his efforts to the development of what was formerly known as the Dark Continent.



ROBERT WILLIAMS

Robert Williams has been welcomed at the courts of Great Britain, Brussels and Lisbon, and though modest and quiet in speech he possesses a genius for finance and has wielded a potent influence in countering intrigues against the British Empire in Central Africa. He is a Commandeur de l'Ordre Royal du Lion, Belgium, vice-president of the Katanga Railway Co. and a director of the Benguella Railway.

How Crude Methods Produced Copper When Other Mines Shut Down

A Description of Operations at a Remote Property in Northern Rhodesia

By R. Murray-Hughes
Sable Antelope Mine, via Mumbwa, Northern Rhodesia

THE SABLE ANTELOPE MINE, in Northern Rhodesia, is interesting because it is one of the few copper-producing properties that did not shut down during the terrible slump in the price of that metal during 1920 and 1921. This was not owing so much to phenomenal management or extraordinary richness of the deposit as to lack of labor trouble, or strike involving actual losses or increased wages. The labor was black.

Much has been written of the disinclination of the native to work, whether in Africa, India, or any other non-white country. In his favor it must be said that he is an agriculturist; his wife (or wives) does most of the routine work, and that we ourselves have taken quite a few hundreds of years to approximate working efficiency. Although natural, it is asking too much for him to conform to our standard of work when we consider that it is only in the last few years that he has been introduced to a shovel and pick. In writing thus, I refer to territory north of the Zambesi, for in the south, I believe, a civilized product may be seen.

The Sable Antelope, admittedly, is not big property, but most will realize that, even when cut down to the minimum, any work calling for the reduction of copper ore must employ a certain number of trained men. The mechanical department may be reduced to the control of a mine pump, an engine, and a boiler, but even such simple units call for skill in operation. For this purpose the local native, whose villages are close to the mine, has been trained, and this labor prides itself on the fact that no alien native from the south is employed.

In the mining department, the law calls for a white supervisor; further, he is economically necessary, for in drilling a round the native's natural laziness will make him point his hole as the most comfortable position, for drilling guides him, and not as the blast demands. In smelting, the charge cannot be weighed, but suitable measures can be made, and if the native foreman on the charging floor is left with these, no white shift boss is necessary; the work on the tapping floor calls more for brawny arms than for brains. Presenting such a concrete case, the saving effected by this last arrangement is shown as follows:

Three white shift bosses at £30 per month.....	£90	0	0	Three native foremen (charging floor) at 30s. per month.....	£4	10	0
				Three native foremen (tapping floor) at 20s. per month...	3	0	0
				Saving.....	82	10	0
	£90	0	0		£90	0	0

It is acknowledged that to operate a large plant good white labor is necessary, but in the present case the money required would have entailed a substantial loss on the year's work, whereas under the conditions outlined above expenses were paid even at the worst of times.

The history of the property dates from 1900, when a concession was granted to the Northern Copper Co. The area covered by this concession is in form an inverted triangle, the base of which forms the northern boundary, marked by the Kafue River between longitude 26 deg. 40 min. and 27 deg. 5 min. E. The apex lies on latitude 15 deg. S. The average altitude is 3,700 ft. above the sea. This area was prospected by the company, but only two of the prospects were developed to a stage beyond a shallow shaft; these were the Sable Antelope (longitude 26 deg. 55 min. E., latitude 14 deg. 37 min. S.), and the Silver King, 8 miles further west. In common with the other discoveries, these were marked by ancient workings.[1] At that time, and for many years after, the company was greatly handicapped by lack of good and cheap transportation. The railway from Bulawayo did not reach Broken Hill, the nearest point to the concession, until 1908, and even then there remained 120 miles over which to make a connection; this was done by heavy traction engines, a method of transport which could never have been cheap. The company confined its activities to producing matte only, and this was shipped in bags to Swansea for further treatment. No figures are available, but after producing a considerable quantity of matte, the Northern Copper ceased operations in 1912. In 1914, the two mines

R. Murray-Hughes

[1]Murray-Hughes, R.: "Native Copper Smelting in Africa." *Eng. & Min. Journal-Press*, Vol. 114, No. 12, 1922, pp. 490-491.

Natives hauling supplies through tsetse fly area

were leased to a tributer, G. S. Ludlam, who has kindly permitted these notes to be published.

The geology of the deposits presents many interesting features. The rocks in which the ore is found have been mentioned by F. E. Studt[2], who has named them the Broken Hill beds. They form a series of sandstone, dolomite, limestone, and shale, of which the carbonate rocks are the principal ore carriers.

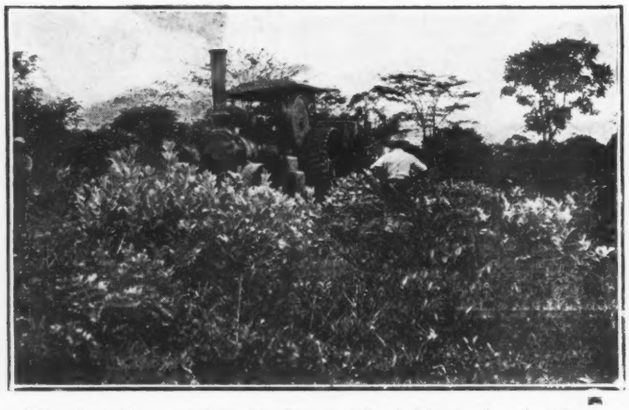
In the parts of the concession where the relations of the igneous and sedimentary rocks may be studied—for example, on the road passing from the Sable Antelope mine to the government camp at Mumbwa—it is seen that the first are intrusive into the sediments and are not of a normal type, but present differentiation facies of a main mass of granite, which swells out in a westerly direction to fill the "Hook of the Kafue." Orthoclase rock, rich in magnetite, found along the above route, and the lamprophyre, found in the workings of the Silver King mine, represent the last manifestation of igneous activity.

The sediments carry no fossils, but from their general position and lithological resemblance to rocks of the South African system are believed to be pre-Devonian.

The road from the Sable Antelope to the Silver King, which is 8 miles further west, runs in a direction nearly parallel to the strike of the carbonate rocks, which show an average dip of 40 deg. to the south. Weathering yields a red sticky soil, which although deep in spots, can hardly average more than 2 ft. The wash-away is great and leaves massive outcrops, which in a few instances tower up to 50 ft. The weathering of the breccia, with which the orebodies are associated, is of a different type, being more typical of weathering by insolation, a process producing low hog-backed outcrops from which the rock breaks away in flat slabs. The soil contains abundant nodules of iron and manganese oxides, varying in size from 1 mm. to 30 and 40 cm. They are derived from the corresponding carbonates which are contained in the breccia.

Ankerite is particularly common, and the irregular replacement of the rock by iron compounds, which give it a brown color forming dark tongues and patches here and there, reminds one of some disease by which the rock might have been affected. In those places where ferric iron is predominant the rock takes on a cerise color and carries veins, 1 to 2 mm. wide, of hematite.

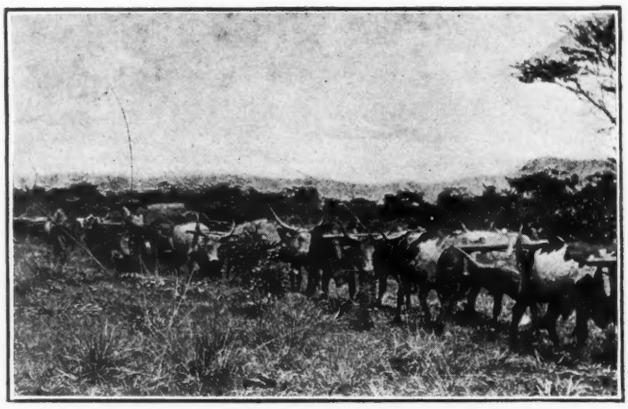
[2]Studt, F. E.: "Geology of Katanga and Northern Rhodesia." Trans. Geo. Soc. of S. A., Vol. XVI, 1913, pp. 59-61.



The traction engine is also used at times for haulage in the fly area

No Oxidized Zone in Sable Antelope

At the Sable Antelope mine erosion has kept pace with weathering and no leached or oxidized zone exists. Bornite, chalcopyrite, and tennantite, disseminated in the breccia and in some places forming the cement, appear at the surface quite unaltered; a body of low-grade ore results. It is 200 ft. long, strikes northeast, dips steeply to the east, and has a slight rake to the southwest. It has been developed to a depth of 300 ft. only. Little information may be gained at present, as the mine is not worked and is under water. The level of the water varies seasonally, from 60 ft. following the rains, which average a fall of 41.59 in., to 100 ft. prior to their falling. A careful search of the dump has been made for traces of the lamprophyre as seen at the Silver King, but unsuccessfully. The relation of the ore minerals as disclosed at the surface appears to persist to the lowest point attained in mining.



Cattle transport in region free of tsetse fly

Leached to Depth of 100 Feet

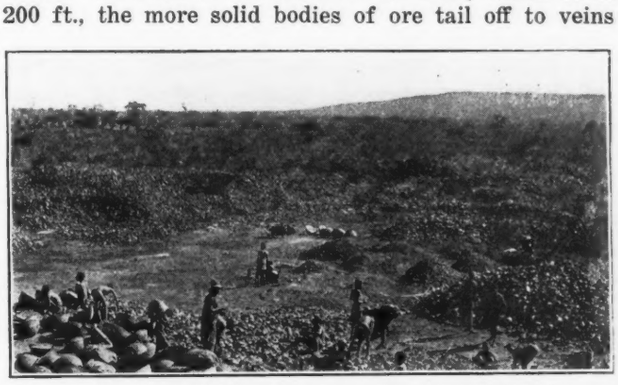
The Silver King orebody bears little semblance to that of the Sable Antelope, although occurring in similar country rock. Injection by lamprophyric dikes has formed a pseudo shear zone, 50 ft. wide, which is followed by the metallization; it strikes a few points north of east, and the dip of the most prominent dike is 70 deg. to the south. This shear zone is marked by an iron gossan 200 ft. long; in it leaching is complete down to 100 ft., the only trace of copper being found by way of "paint" malachite here and there. The lamprophyre is weathered out of all recognition down to 70 ft., forming a filling of loose soil between the rocks. At 100 ft. it retains its structure, but under the microscope appears

as a clayey mass. At 200 ft. (100 ft. below water level) the rock is more solid, but it is a disappointing fact that even at that depth thin sections are of little value. At first I mentally dubbed it the "slickensided and talcose crush-breccia" of F. E. Studt, but as development and mapping proceeded, lack of definite orientation in the minor slips, and other structural features, suggested that the rocks had been affected by igneous metamorphism rather than dynamic. Representing the key to the situation, the correct determination of this rock was highly important, and I felt justified in submitting a duplicate specimen to an authority. W. Campbell Smith, of the British Museum, was kind enough to examine it and wrote as follows: "The specimen is, as you say, very much altered. In thin section it shows the habit and general appearance of a camptonite . . . In any case, I think the rock must be a dike and if not actually a camptonite, some other member of the lamprophyre family."

On both sides of the dikes joints have developed, which have allowed the free passage of surface water carrying abundant iron; varying from 1 to 4 ft. in depth the breccia has been altered to a compact iron-stone containing abundant quartz. In the higher levels everything is masked by the heavy weathering, to which the lamprophyre is highly susceptible; calcite, limonite, and siderite in a mass of undefinable earthy material form the country rock.

Some Malachite in the Orebody

The pay shoots are the result of enrichment and are found at an average depth of 120 ft. They appear as small, unevenly distributed masses of chalcocite replacing both dike and dolomite. A defined oxidized zone does not exist, although in a few spots the chalcocite that has replaced the dike has been altered to nodules of crystalline malachite—this owing mostly to its inherited structure facilitating the circulation of surface water. At the base of the enriched zone, which is at 200 ft., the more solid bodies of ore tail off to veins



Gang of "picanins" breaking up slag and matte

ranging from 2 to 5 cm. in width; they show a central filling of chalcopyrite bordered in turn by bornite and chalcocite. Pyrite has not been found.

The chalcocite is argentiferous, but the only mineral of silver seen is native silver in the form of fine films spread over the inherited joints of the chalcocite; the films cannot account for the main silver content.

An interesting feature of the deposit is a solid chimney of chalcocite, which at one time extended from the surface down to 200 ft.; it lies at the most easterly point of the deposit. The chalcocite cropped out at the surface, and no leached or oxidized zone was found; malachite appears throughout the ore in an incipient fashion as a result of recent oxidation. The chimney was somewhat funnel shaped, being at the surface 50 ft. and at the lower level 4 ft. in diameter.

Smelting buildings and weighing shed. Wagons carrying copper ingots

Direct evidence of the manner in which this body of ore was brought into existence has been, and still is, difficult to obtain, because of the extreme weathering of the upper levels in the country west of it, which is the only side that has been developed, and the paucity of development on the lower, less-altered levels. On the 200 level a characteristic, finely bedded pink limestone is seen. It has been affected by the intrusion and shows numberless small veins of calcite, which contain in a few spots specks of chalcopyrite. This rock does not crop out at the surface except as large blocks in a broad crush-breccia, which cuts across, at an oblique angle, the eastern end of the zone of intrusion by the dike. Although further confirmation is necessary, my opinion is that this north-south post-intrusion fault raised the already enriched eastern orebody above the level of its origin by at least 150 ft., thereby initiating a double enrichment, resulting in the chimney of solid chalcocite.

Silver Occurs in Different Forms

Peculiar conditions would have been set up at this point by the bringing together of a large sulphide body, resistant to alteration owing to the absence of pyrite, and a thoroughly permeable area as presented by the easily weathering horizon on the west. These conditions have resulted in irregular patches of highly oxidized material along the contact of the two bodies. Among the minerals in this material are baryte, calcite, siderite, covellite, cuprite (massive and in large octahedra) chrysocolla, brochanthite, native silver (in minute dots contained in the laths of covellite), and a haloid of silver, which is always associated with the chrysocolla.

Charcoal kiln burning

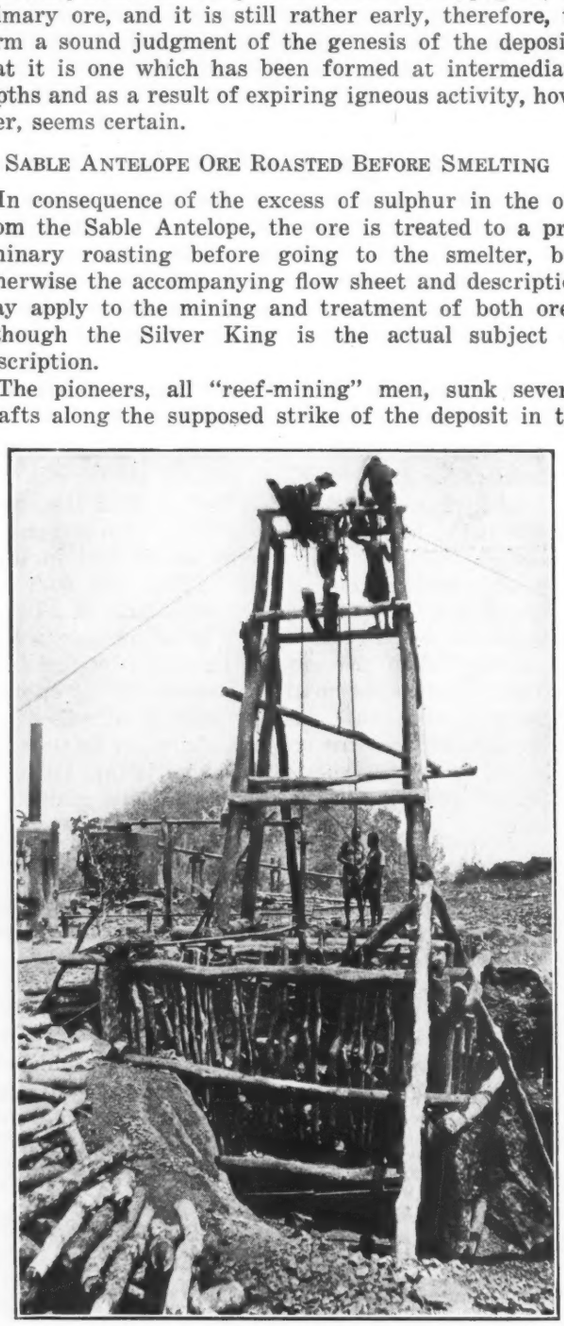
A small crystal of this last-named mineral was forwarded to F. J. Spencer, of the British Museum, who found it to be iodyrite; he informed me that it is the only known occurrence in Africa. Recent and present oxidation results in malachite and cuprite.

Development has not yet uncovered the hypogene, or primary ore, and it is still rather early, therefore, to form a sound judgment of the genesis of the deposit; that it is one which has been formed at intermediate depths and as a result of expiring igneous activity, however, seems certain.

Sable Antelope Ore Roasted Before Smelting

In consequence of the excess of sulphur in the ore from the Sable Antelope, the ore is treated to a preliminary roasting before going to the smelter, but otherwise the accompanying flow sheet and description may apply to the mining and treatment of both ores, although the Silver King is the actual subject of description.

The pioneers, all "reef-mining" men, sunk several shafts along the supposed strike of the deposit in the



Headframe at No. 23 shaft, which was sunk after No. 1 shaft, 60 ft. away, had caved

hope of cutting the "reef" at depth; so that as many as twenty shafts may be found, most of which finish in barren ground, and have been left unconnected with one another.

No. 1 shaft was sunk on the original old working, and passed through nearly 200 ft. of solid chalcocite. The body of ore, semicircular in form, was mined at the expense of the shaft, and as the diameter of the body was as much as 50 ft. in places, a large unsupported cavity was left. After standing a few years, the remnants of the shaft collapsed in 1916. A new shaft (No. 23) was sunk to replace it, and stands 60 ft. away. It is a two-compartment shaft, 9x5 ft. over all, passing through three levels down

Flow sheet showing ore treatment at mill and smelter

to 200 ft. One compartment is used for hoisting, which is done by means of a 3-ft. steam hoist and 10-cu.ft. koko pans, and the other carries the pump columns and ladder-way. The mine is not troubled with a great deal of water, and a 3-in. Knowles sinking pump, at the 200 level, keeps the workings dry.

Ore Mined as Convenience Dictates

Method was introduced into the mining policy during 1922, but it is too much like working in the dark to apply geologic principles to development that is confined to 300 or 400 ft. a year, and in the main mining has been a matter of luck. In these circumstances no one method of stoping has been found possible: once in the middle of the ore, overhand and underhand work, here and everywhere, is the rule. If the ore goes down, a windlass is thrown across, the broken rock hauled to the discovery drift, and from there it is taken by means of wheelbarrows to the main shaft, where it is loaded into the waiting koko pans. The steam hoist, driven by a native, brings this last to the surface; two doors, across which a short set of rails is clamped, are closed; a carriage is run under the swinging pan, and it is let down into place. From the shaft the ore is run to a sorting dump; the big "stuff" is extracted and sorted, the waste is thrown over the end of the dump, and ore is taken to the dump of coarse ore. The remaining material is hand screened (minus 1 in.), the oversize goes to washing tables, and the fine to the concentrating machines. The work is done by "picanins" earning an average wage of 5s. per month.

The washing tables are made of three 9x3-in. planks clamped together with a 2-in. ledge fixed to either side, and are tilted at an angle of 10 deg. At the higher end, a spray of water plays over the table, and, as the oversize is thrown on to it, the pieces are freed of the covering muddy material, enabling more "picanins" to extract the bright glance.

The concentrating machines work on the same principle as the diamond rotary washer. Standing upright in the center of a circular pan, 6 ft. in diameter and 8 in. deep, is a spindle to which are attached six arms

carrying four to five iron teeth; each tooth is flattened to a width of 1 in. at its lower end and reaches to within ¼ in. of the bottom of the pan. The teeth are so arranged that every tooth travels in a circle one-inch greater in diameter than that in which the preceding tooth does, and all are set at an angle of 40 deg. to the arm holding them, the angle pointing away from the center. On the upright spindle, which is revolved by means of a cross-bar and bevel gearing turned by two natives, a centrifugal action is set up, and if a discrete mixture of light and heavy particles is fed into the pan containing a medium that will support the light but allow the heavy particles to sink, a concentration of the latter will take place at the periphery of the pan, from where the concentrate can be tapped at regular intervals; the lighter particles of gangue overflow through a central opening, which is left 3 in. above the base of the shield surrounding the main spindle. The separating medium is water thickened with clay until the necessary consistency is reached to support the limestone or other gangue material, but to allow the ore to sink. One machine produces one ton of concentrate a day. The following analyses show results attained[3]:

	Silver King		Sable Antelope	
	Heads	Concentrate	Heads	Concentrate
Cu	7.93	27.06	9.67	20.31
Insol	18.10	12.78		
FeO	24.14	14.58		
CaO	22.50	15.04		

Analyses are attached also, showing the composition of the coarse ores.

	Silver King Picked Bonanza Material	Silver King Average Material	Sable Roast Ore
Cu	38.90	12.18	17.71
Insol	7.50	14.14	4.22
FeO	10.79	18.72	21.07
CaO	16.11	15.34	15.22
MgO	.72	6.31	6.36
S		3.54	9.12

After sorting and concentrating, the ore is carried in wagons from the Silver King to the Sable Antelope mine, where the smelter is situated; each wagon carries five tons.

In the absence of sampling machinery, it is necessary to take a sufficient number of cuts from the dump of coarse ore, which is done as it is being knapped, and a sufficient number of "pipe" samples (on the principle of cheese testing) from the concentrate, to satisfy the chemist that a nearly true average is found of the composition of the two. Applying the ordinary principles of sampling, extraordinary results are rejected, and when, for example, six cuts approximately agree, a composite sample of the six is made the object of a final analysis, and a smelting charge is calculated on the result.

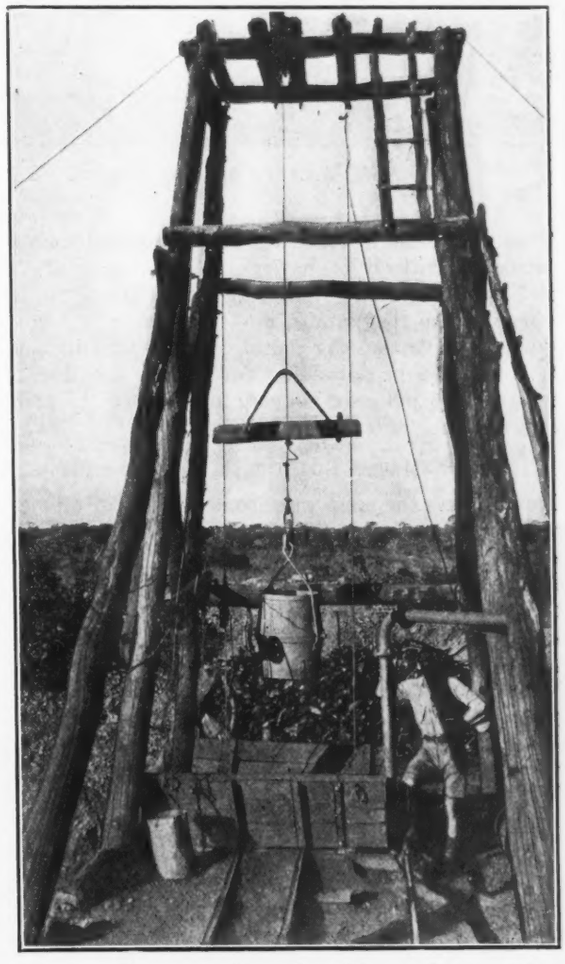
Fluxing Gave Trouble in Past

A silica and an iron flux are required; the former appears to have caused a deal of trouble in the past. First, a compact quartzite was used; this, in consequence of its texture, would just fuse around the edges, and a freeze-up would follow. Second, a highly porous rock, with the following composition, was used: Insoluble, 68.15 per cent; FeO, 13.95 per cent; CaO, 1.01 per cent; MgO, 0.06 per cent. It was so light, however, and such a large volume was required to make up the weight, that it did not pay to mine it. Third, bricks made of loose sand were molded and baked. These acted well, and would still be in use were it not for the discovery of a suitable sandstone. This analyses 96.38 per cent insoluble (all quartz grains) and 1.28 per cent FeO, and is quite porous; when fed to the furnace in pieces not larger than 2 in. it acts as well as the bricks.

Material from a deposit of "wad" is used for the iron flux; its composition is as follows: Insoluble, 2.46 per cent; FeO, 18.18 per cent; MnO, 29.52 per cent. The charge is kept moderately low in silica, and high magnesia is diluted with a small addition of foul slag. A typical result is shown by the following analyses:

	Calculated Slag, Per Cent	Actual Slag, Per Cent
SiO2	42.47	45.82
FeO	25.64	26.19
CaO	27.41	24.68
MgO	4.46	3.34

The fuel in use is charcoal.

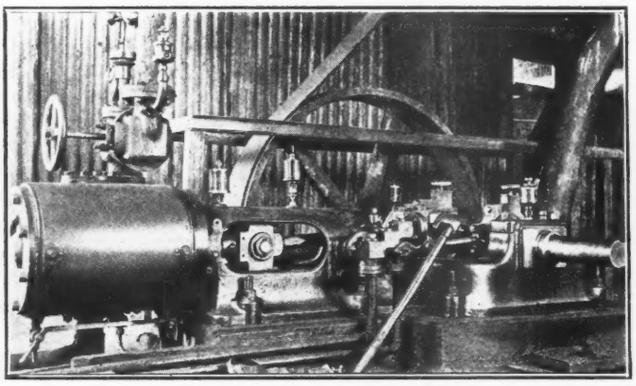


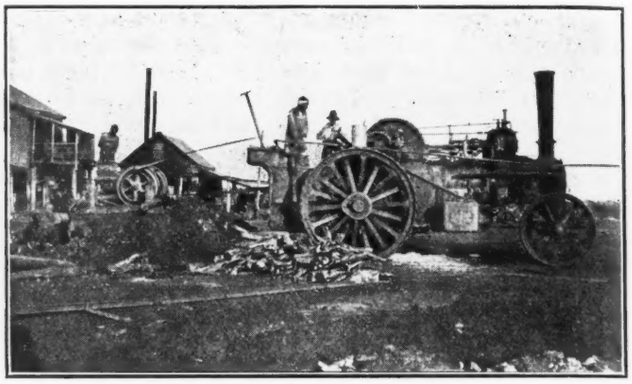
Arrangement for surface dumping and tramming at No. 23 shaft

Matte Tapped Frequently

The furnace is of the circular type measuring 3 ft. 6 in. at the tuyères. It has not been found practicable to use an outside settling hearth, so that matte is tapped every half hour direct into molds. The plant used in running the smelter is composed of one 12-hp. boiler, a Marshall horizontal engine, a Roots blower, and a 3-in. Knowles rocker-bar pump. The arrangement is of the usual type.

[3]All analyses were made by the writer with the following exceptions, which were made by G. S. Ludlam: Silver King picked bonanza ore, "porous rock."





Left, Smelter blowing engine. Right, Traction engine used to run rock crusher

Three eight-hour shifts are employed, and each shift is made up entirely of natives. A day gang of "picanins" breaks up the cooled slag and matte; the latter is taken to the roast-stalls, and the former is run away in koko pans to the slag dump. An intermediate product, foul slag, is put aside for future treatment; it carries 4 to 5 per cent copper, in the form of prills of matte and "metallics."

Matte Roasted in Stalls

Now follows the most wearisome process of all—roasting the matte. Ten tons is loaded into each stall over a good bed of dry wood. From the first roast, one ton of suitably oxidized matte may be recovered; from the second, three tons, and that is the maximum, for after the second roast fresh matte is added to fill the stall. Five days is allowed for the roasting, and three for "digging out." The "digging out" overlaps the roasting, for it starts on the third day after lighting. Two natives are put in each stall, and as they break down the fritted mass, they sort the oxidized matte from the other, which they know by its rounded and less altered appearance.

The roast matte is introduced into the smelter charge at the beginning of a run, in such a proportion as to yield a bar of copper averaging 350 lb., every hour. That the roasting is not "sweet" may be gathered from the fact that 1,100 lb. of matte is required to produce such a bar. A run seldom lasts longer than a fortnight owing to the avaricious appetite of the smelter; the wagon transport and other subsidiary work such as charcoal burning are not able to keep up with its demands. During the smelting period, 200 tons of black copper is produced that assays 96 per cent copper and 40 troy oz. silver to the ton. It is cleaned of adhering matte, weighed off into 5-ton lots, and loaded on wagons, which take it to the railway line for shipment to New York.

Natives loading ore-roasting stalls. Small reverberatory at left

The seasonal rains put a stop to smelting. Roads are made impassable for the wagons, charcoal burning is stopped, and labor returns to its villages to make sure its wives are planting. In December, therefore, attention is turned to the year's collection of foul slag to which reference was made previously. It is crushed to minus 1 in. by a 10 x 8-in. crusher which is run by a small marine engine situated in the "shops," and the fine is treated in the "washing machine." The concentrate assays: Copper, 34.29 per cent (matte) and 1.11 per cent (metallics); the tailing assays 2.77 per cent copper, and the recovery is 36.6 per cent.

It is not necessary to walk far to see waste here, and waste there, but to increase the efficiency to any appreciable extent five white men, at least, would be required. Their combined wages and salaries would amount to over £2,000 per annum, and it is questionable whether the increased efficiency would produce half that sum.

A New Kind of Ore

One of the early-day characters of the Black Hills was long-haired Bill McMillan, who had a penchant for big words. Among the miners, he held forth as quite a rock-sharp. For some unaccountable reason he was "subpoenied" as a witness in a case at Deadwood involving, among other things, a dispute as to the character of certain ore deposits. After such experts as Professor Jenney and John Farrish had testified, Bill was put on the stand. Handing him a piece of rock, the lawyer said to him:

"Now, Mr. McMillan, remember that you are under oath as an expert. You are a mining expert, are you not?"

"No sir, I ain't," said Bill. "I am just a plain, scientific prospector and a geological calculator."

"Well then, please tell the Court whether or not, in your judgment, as the kind of an expert you say you are, the rock you have in your hand is porphyry."

Bill turned the sample over once or twice, wetting his finger and knowingly touching the rock here and there, all the while stalling for time—and finally delivered himself of this clincher:

"Well, now, I wouldn't call it porphyry. To my notion that rock is just plain ozote—locally better known as—as—oxide of polygamy."

Bill's reputation as a mining shark was thereafter never questioned in those diggings.

When Will California Reach Its Peak of Oil Production?

*A Study of the Present Situation**

By Joseph Jensen
Petroleum Geologist, Los Angeles, California

THE OIL INDUSTRY wants California to answer two vital questions, and California is just as interested to know the answers to the questions as is the oil industry. These two questions are, first, "When has California reached, or when will California reach, its peak of production during the present overproduction of oil? and, second, "When will the consumption of California and the western seaboard equal or exceed the production of California?" The oil industry wants answers to these questions, because California production now affects the oil markets of the world. California desires answers, so that justification may be had for the policy of storing oil and building new storage. If an excess of oil for storage is to continue indefinitely, no organization is large enough to meet the situation. If the condition promises to have a definite end, it is important for California that as much oil be retained within the state as possible. Neither the industry nor California can continue indefinitely under the present load.

"THE OUTLOOK for the future is definite. . . . The end of overproduction in California will come within the next year. . . . The heavy load now being carried by the oil industry will be reduced in another six months."

"The production of California will fall below its indicated future consumption. There will be a shortage of production, and intensive drilling rather than conservative drilling may be necessary to make up the difference. This difference between consumption and production will therefore represent a margin of safety to take care of any intensive development that may occur in the new fields in the areas where small parcels of land exist and rapid drilling may be necessary."

Definite opinions may be expressed as to these two questions, but the future alone will give the final answer. The purpose of this paper is to discuss them and consider the factors bearing upon the situation.

State's Production Now at Maximum

Answers proposed as a result thereof are, first, California is producing its maximum at the present time; second, there will be no surplus production during the latter part of 1924, even assuming that beginning next January oil now shut in the older fields is produced as freely as oil is now produced in the newer fields.

These answers are based upon a study of conditions in all of the fields. Those of most interest are Santa Fe Springs, Signal Hill, and Huntington Beach, and they will be discussed more fully.

As to each of the older fields, the following explanation is made, and the statistics quoted are those of July, 1923:

The Kern River field has 2,166 wells, producing 19,500 bbl. per day. These wells have an average drainage area of 2.4 acres. Little drilling is being done in the field, and its production is perhaps the most settled of the state. No production is shut in. Estimated January, 1924, production is 19,800 bbl. per day. Estimated December, 1924, production is 19,200 bbl. per day.

The McKittrick field has 277 producing wells. These wells have a drainage area of about two acres per well. Only a little drilling can be done in this field, and its production is declining slowly. It is now producing at the rate of 6,000 bbl. per day, and there is only a small amount of shut-in production. Estimated January, 1924, production is 6,000 bbl. per day. Estimated December, 1924, production is 5,700 bbl. per day.

The Midway Sunset field has 2,078 producing wells, but a year ago it had 2,542, and the difference probably represents some wells that are entirely shut in. These wells are located one well to each five acres. Its production is now 73,200 bbl. per day. The production of this field should decline slowly. If conditions warrant, additional drilling will be done during the latter part of 1924. Estimated January, 1924, production is 81,000 bbl. a day. Estimated December, 1924, production is 77,300 bbl. a day.

The Elk Hills field has 94 wells producing, but a year ago there were 153, the difference being approximately accounted for by shut-in production. Each well has an average drainage area of eight acres. The field is now producing 23,700 bbl. per day. There are a large number of drilling locations in this field, and conditions will probably require the bringing in of new production by July of 1924. Estimated January, 1924, production is 21,000 bbl. per day. Estimated December, 1924, production is 28,000 bbl. per day.

The Lost Hills Belridge field has 284 wells producing 3,800 bbl. per day, but a year ago there were 516 producing wells, spaced one well to each four and one-half acres. This production has declined rapidly in the past, but is now partially shut in. Very little drilling can be done in this field. Estimated January, 1924, production is 4,800 bbl. a day. Estimated December, 1924, production is 3,300 bbl. a day.

The Coalinga field has 676 wells producing, with a daily production of 13,211 bbl., but a year ago there were 1,219 wells, spaced one well to 6.1 acres. This indicates that a large amount of the production of the Coalinga field has been shut in. This is estimated as high as 30 to 50 per cent. Estimated January, 1924, production is 30,000 bbl. a day. Estimated December, 1924, production is 27,100 bbl. a day.

The Santa Maria field has 327 wells, producing 6,400 bbl. of oil per day. These wells are spaced one well to each 10½ acres. The Santa Maria field is now shut in to a large extent. Estimated January, 1924, production is 12,600 bbl. a day. Estimated December, 1924, production is 11,700 bbl. a day.

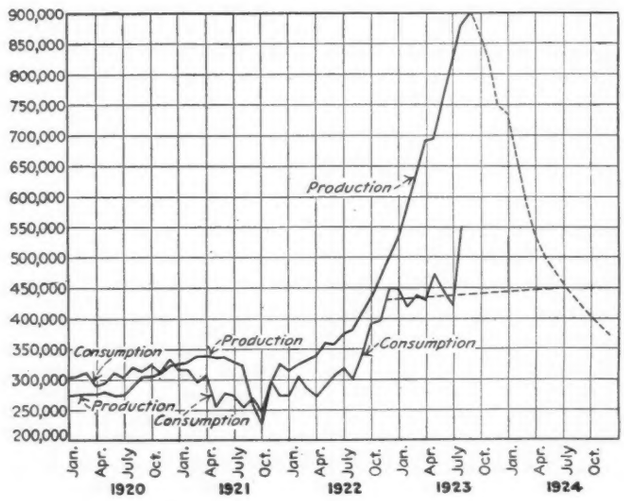
Summerland and Watsonville are two small fields from

*Presented before the recent Los Angeles meeting of the American Association of Petroleum Geologists.

which no new production will be secured. The former produces 150 bbl. a day; the latter about 50.

Wheeler Ridge is a new field at the southern end of the San Joaquin Valley. The anticline in this field is a sharp one. Some new production will be secured, but thus far the field has not shown characteristics sufficiently strong to justify the expectation of large production. One well was completed in July with an initial daily production of 285 bbl. Only nine wells are drilling, and one new rig has been erected. Estimated January, 1924, production is 300 bbl. a day. Estimated December, 1924, production is 400 bbl. a day.

The Newhall and Ventura County district embraces a large area from which a production of 10,632 bbl. per day is being secured from 538 wells, scattered through many old fields. In this district, the Ventura Avenue anticline alone will be a source of new production. Land on this structure is held by a few of the larger companies, so that



Curves showing entire California production and consumption

drilling will be well controlled and at a slow rate. In the entire district there are now only 41 wells drilling, and on the Ventura Avenue anticline wells have been completed at a rate of less than one per month. Estimated January, 1924, production is 11,300 bbl. a day. Estimated December, 1924, production is 13,200 bbl. a day.

The Old Salt Lake field is producing from 276 wells at a daily rate of 2,500 bbl. Such new drilling as may be done in this field will not materially change the amount of production it can make. Estimated January, 1924, production is 2,400 bbl. a day. Estimated December, 1924, production is 2,100 bbl. a day.

There are an extremely large number of old wells producing in the Los Angeles City field, but these pump only at the rate of about one barrel per day. Estimated January, 1924, production is 600 bbl. a day, with the same figure for December, 1924.

The Montebello-Whittier field is producing 12,000 bbl. of oil per day from 300 wells. There are only seven drilling wells in these two fields. A steady but gradual decline of production may be expected from this district. Estimated January, 1924, production 15,700 bbl. a day. Estimated December, 1924, production is 12,800 bbl. a day.

The Coyote field is producing 2,500 bbl. of oil a day from 111 wells. A year ago the field was producing from 228 wells, spaced one well to each five acres. A year ago the field produced from 20,000 to 25,000 bbl. per day. Production in this field is shut in perhaps more than in any other field. Estimated January, 1924, production is 18,100 bbl. a day. Estimated December, 1924, production is 17,000 bbl. a day.

The Fullerton field is producing 11,200 bbl. of oil per day from 384 wells, and the shut-in production amounts to less than 2,000 bbl. per day. A deep sand has been found on one of the domes of this district, but the physical condition of the well does not promise that it will furnish a large quantity of oil. It will take from four to six months for other wells to prove the value of this discovery. Even if the discovery proves of marked value, it will be a year before any added oil will be produced from this field. Estimated January, 1924, production is 11,700 bbl. a day. Estimated December, 1924, production is 10,100 bbl. a day.

The Richfield field is producing 16,500 bbl. of oil daily from 176 wells, spaced one well to each 4.4 acres. A deeper sand has been found in the southeast anticline of the Richfield field. It is capable of producing about 300 bbl. of heavy oil. This discovery will not materially change the amount of oil that the Richfield field will produce. Estimated January, 1924, production is 15,000 bbl. a day. Estimated December, 1924, production is 11,900 bbl. a day.

The Torrance Redondo field is not an old field. It has 33 producing wells, from which 4,500 bbl. per day is secured. The best well in the field is only producing 900 bbl. per day. This well is in an area where many small lots exist. Since July, six more wells have been brought in, and the daily production of the field is 6,000 bbl. If wells no larger than those thus far found are secured, the field will in no way be an important factor in the present situation. It will hardly make up for the decline in production of the older fields. Though the true position of the structure in this field has not been found, most of the land is held in large tracts and is under lease to large companies that will not drill it too rapidly. It is possible that deeper sands will be found, and that when the crest of the structure is located, larger wells will be secured. Estimated January, 1924, production is 8,000 bbl. a day. Estimated December, 1924, production is 25,000 bbl. a day.

Compton Field a Prospective Large Producer

The new Compton field is the latest discovery in southern California. Unquestionably, this field will eventually be a companion field to Huntington Beach and Signal Hill. Geological conditions are much the same in all three fields. Dominguez Hill, on which the discovery well is located, is a much more prominent topographic feature than the elevation at Huntington Beach. The discovery well came in at 950 bbl. per day, and has since increased in production to about 1,300 bbl. Deeper sands may be expected, and also larger wells. Estimated January, 1924, production is 1,000 bbl. a day. Estimated December, 1924, production is 10,000 bbl. a day.

The presence of the undeveloped fields at Wheeler Ridge, Torrance, and Compton will not affect the present peak of production. Santa Fe Springs required from Oct. 28, 1921, until January, 1923, before it was able to produce 90,000 bbl. of oil per day. Long Beach required from June, 1921, until January, 1923, before it was able to produce 100,000 bbl. per day. Huntington Beach required from June, 1920, until January, 1923, before it was able to produce 80,000 bbl. per day.

From the foregoing data it will be seen that more than a year's time was necessary to bring each of the big Southern California fields from relatively no prodution to 100,000 bbl. The cause of this rapid increase in production from these three fields was the fact that each of them was located in an area consisting almost entirely of small parcels of land. This caused the close spacing of wells, and rapid competitive drilling. Even should the three new areas be drilled as rapidly, it would take a year before they would be factors of material importance. Fortunately, each of these three fields contains many large tracts of land. The companies holding leases on these tracts have always conducted their operations in a conservative manner, and with respect to the general oil situation. Drilling requirements on their leases are particularly liberal. The fields will therefore not be drilled rapidly, but rather slowly. They will not reach their peak of production for at least two years, and when this peak is reached

it will not be as high as the peaks of Santa Fe Springs and Signal Hill.

As will be shown later, the production of California will fall below its indicated future consumption. There will be a shortage of production, and intensive drilling of these fields, rather than conservative drilling of them, may be necessary to make up the difference. This difference between consumption and production will therefore represent a margin of safety to take care of any intensive development that may occur in the new fields in the areas where small parcels of land exist and rapid drilling may be necessary.

Three Methods Used for Estimating Future Production

The more difficult part of this forecast is a determination of what the future production of Santa Fe Springs, Signal Hill, and Huntington Beach will be. There are several methods of estimating their future production. Three of these have been used as to each field.

The first, referred to as Method *A*, represents the results secured by estimating as to each individual well the time of its completion and its initial production. The decline in production of each individual old well and new well is then determined from a decline curve. These totals, when added up, give the result of Method *A*.

The second method, *B*, represents the results secured by multiplying the daily average production per well by the total estimated number of producing wells. Each of these units is determined by projecting the curves of the past into the future, giving due consideration to elements bearing on each of them.

The third method, *C*, consists first of estimating the average rate of decline of wells producing at the first of each month, for that month, and adding thereto the estimated new production to be produced in that month, after deducting one-fourth of the new production which represents its decline during that month. To determine the rate of decline of existing production as of the first of the month, the decline of production existing on the first of April and each succeeding month has been segregated. This shows that as to each of such items the rate of decline after the first month is more gradual than during the first month. The existing production as of Sept. 1 was declined during the next four weeks at a rate suggested by the actual decline of the production existing on the first of the several preceding months. The amount of the estimated new production was secured by projecting the average daily initial production per new well into the future and multiplying it by the total number of new wells each week. This latter item was an average secured by plotting the number of new wells completed in previous months. The product secured by multiplying the average daily production per new well by the number of new wells per week represents the total new production per week. The total new production per week in weeks past was also secured from a curve, and by trial the future new production was made to agree with the product secured by considering the other two items separately.

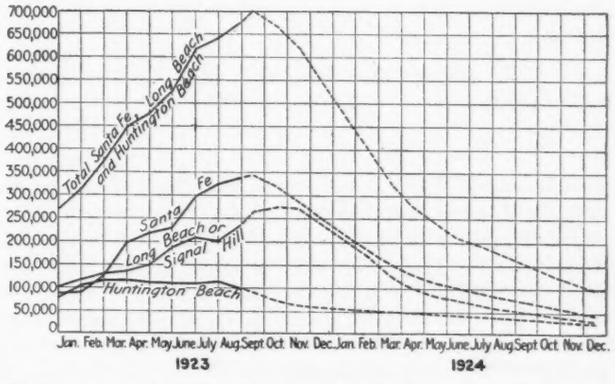
These Methods Faulty

Each of the foregoing three methods is subject to certain criticisms and has certain weaknesses.

Method *A* almost invariably gives results higher than those actually secured. This is due to the fact that every well is assumed by this method to be completed. The rate of drilling is usually assumed as slower than actual practice to adjust this feature and to take care of drilling delays. The effect of assuming that every well that is drilling will be completed results in having too many producers. In attempting to estimate what the new wells will produce, one is likely to be too conservative on the wells that will be coming in within a few months, and not conservative enough on the wells that will come in several months hence. This causes the results of Method *A* to appear very conservative the first month or two, and then to be too high in the future. It is difficult, where close drilling has been done, to estimate what new production will be three or four months in the future. Though estimates made by this method have usually approximated the actual results secured, it has generally been the practice to revise estimates made under Method *A* at short intervals. This method requires a most intimate knowledge of conditions existing in the field. It is cumbersome, because of the large number of wells that must be considered. It does not take into account difficulties that may arise as to producing wells, such as casing trouble and the encroachment of water.

Method *A* has appeared attractive and reliable because the production of early producers was estimated at a lower figure of production than that at which these wells came in. The wells that failed to come in were not missed, since the total of actual production later recorded agreed fairly well with the estimate of Method *A*.

Method *B* is the quickest method of making a forecast, as only two elements are considered—namely, average daily production per well, and the number of producing wells. Thus far, in these three fields, the change



Curves showing actual and estimated average daily production of Santa Fe, Long Beach, and Huntington Beach fields

in these two items has varied less, from week to week, than any others. More units are involved, and any changes in the future will therefore be less marked. The objection to the method is that it must assume fundamentally that conditions will continue in the future as they have in the past. This cannot be so, for the reason that eventually the field will be drilled up. Problems that formerly were negligible because of the high gas pressure will more and more assert themselves. Since the amount of probable future production promises to be less and less, the ability of the small operator to re-finance by paying out of oil becomes less certain. This makes it inevitable that more drilling wells will fail to be completed than in the past.

Another objection to Method *B* is the fact that it

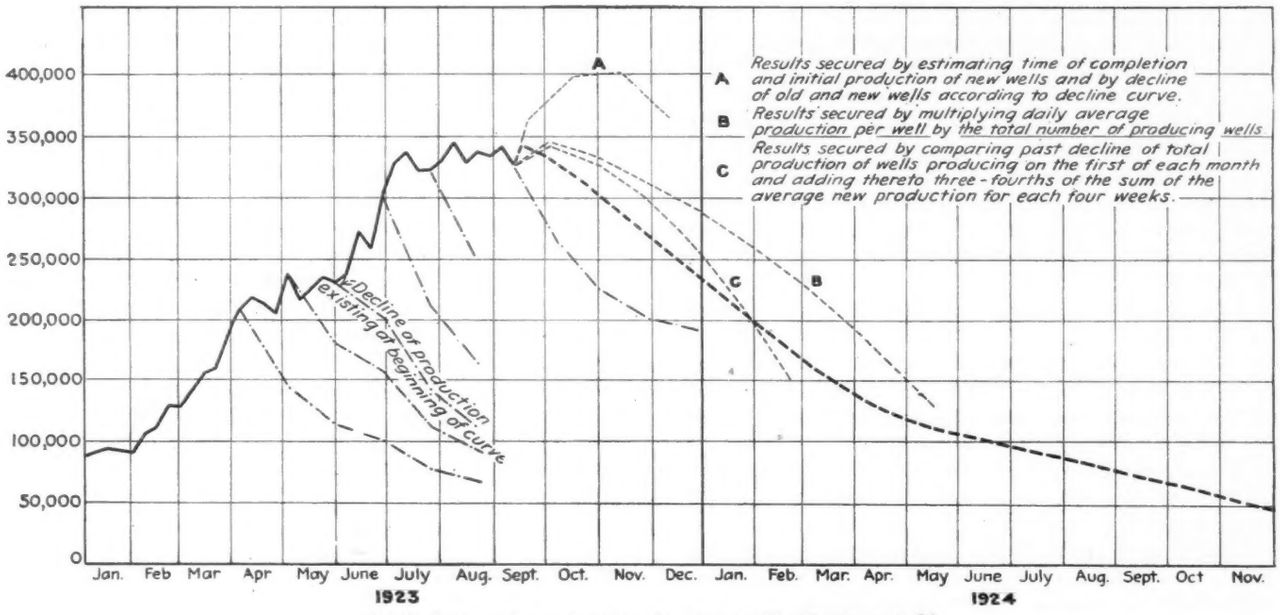
does not take fully into consideration water problems that are now beginning and that from present indications will become important.

Method *C* is somewhat longer than Method *B* to apply, but even so it is much shorter than Method *A*. If the southern California fields had not been subject to frequent prorating and to partial shutting in of wells, the decline of the production existing at the first of each month would have been regular. Nevertheless, and despite this condition, the rate of decline during the first month for the production existing at the first of April and on the first of months following has been fairly uniform. When there are no more completions, the old production may be expected to decline in subsequent months in much the same manner as did the daily initial production per new well by the number of new wells per week—some of the disadvantage of this great variation has been eliminated.

In the curves that are submitted for the three fields, the final estimate of average daily production for the field in the future has in most cases been assumed to be less than the figures shown by any of these three methods, in order to give weight to factors which none of the methods are able to consider. These factors are the rapid decline in gas pressure, and the increasing effect that water problems will have in the future.

Date of Peak Production Varies With Method

The application of the above methods to the three fields may now be explained.


400,000
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A
B
C
Results secured by estimating time of completion and initial production of new wells and by decline of old and new wells according to decline curve.
Results secured by multiplying daily average production per well by the total number of producing wells
Results secured by comparing past decline of total production of wells producing on the first of each month and adding thereto three-fourths of the sum of the average new production for each four weeks.
Decline of production existing at beginning of curve
Jan. Feb Mar Apr May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct Nov.
1923
1924

Well data and production for Santa Fe Springs field

production of April 1 and months following. The decline will be less rapid than this, rather than more rapid, for the reason that when the field is fairly well drilled up, the production will be more settled, and each well will decline at a slower rate than it did in the earlier part of its life. As the old production in the future will be an increasingly larger component in Method *C* than the new production, it is clear that the decline of the total production of the field following the first of each future month should be assumed as a less amount than that indicated during the earlier life of the field. In the application of Method *C* on these curves, this element was neglected, for the reason that it did not seem possible to know how much weight to give it, and therefore the same rate of decline following the first of September was applied every four weeks in applying Method *C*.

The other component in Method *C* is the estimate of the new production. New production shows a greater variation from week to week than any other element. Obviously, any attempt to project it into the future will be affected by this condition. The number of new wells completed each week has changed almost as markedly from time to time as the new production has changed. However, as the total new production for the week is estimated by two methods—that is, by considering the new production itself and by multiplying the average

Production in the Santa Fe Springs field has climbed from 86,000 bbl. in January to a peak of about 350,000 bbl., which occurred near the first of September. Owing to the fact that some production has been shut in, the increase has not been as regular as it would have been.

Under Method *A*, its peak production would come about Nov. 15, and be 403,000 bbl. This estimate is much too high and will not be attained by the field.

Under Method *B*, a lower estimate is secured. The two components on which this curve is based are average daily production per well, and the number of producing wells. The average daily production per well rose from 1,250 bbl. in January, 1923, to 2,400 bbl. in May, 1923, and has since declined to 1,600 bbl. A continual decline in the future to 400 bbl. by June, 1924, is expected. The number of producing wells has increased regularly from 70 wells in January, 1923, to 200 wells at the first of September. An intimate knowledge of the field leads to the belief that the number of producing wells will not increase indefinitely, but when approximately 320 wells have come on production, new wells put on production will only take the place of old wells that go off production. Both of these assumptions are optimistic. Method *B* shows a peak production of 347,000 bbl. near the end of September and a gradual decline thereafter as follows: November, 333,000; January, 274,000; March, 213,000; May, 133,000. This

estimate is too high, for the reason that when wells stop flowing, pumping will not follow and continue regularly.

Wells Now Pumped From 4,000 Ft. Depth

Though the success of pumping in the Santa Fe Springs is by no means assured, wells are now pumped in California from a depth of 4,000 ft. by using two pump barrels, one at the bottom of the hole and one half way up the hole. If fluid levels in Santa Fe Springs wells are found between 3,000 and 4,000 ft., the wells probably will be pumped. Engineers of supply companies are now at work on the problem. It may be assumed that wells will go off production as flowing wells at about 200 to 300 bbl., and will then begin as pumpers at about the same rate. Such an assumption will tend to show more production than will probably be secured. The same remark applies as to pumping deep wells at Signal Hill and Huntington Beach.

One of the components of Method *C* is a study of old production existing on the first of each calendar month. In the Santa Fe Springs field, this old production has declined about 20 per cent during the calendar month. The new production per week at Santa Fe Springs has varied from 9,000 bbl. per week in April to 22,000 bbl. per week in May, with a peak of 50,000 bbl. per week in June. Its decline has been assumed to be regular, so that new production per week in October will be 20,000 bbl.; in January 9,500 bbl., and in March 2,000 bbl. The number of new wells per week averages seven. The average daily initial production for each well has varied from 3,900 bbl. in March to a peak of 5,500 bbl. in July. It will decline as follows: September, 3,200 bbl. per day; November, 2,900 bbl. per day; January, 2,650 bbl. per day.

The results of Method *C* show a change of production in Santa Fe Springs by months as follows: September, 327,000 bbl. per day; October, 343,000 bbl. per day; November, 315,000 bbl. per day; December, 281,000 bbl. per day; January, 230,000 bbl. per day; February, 173,000 bbl. per day.

Lower Limits of Oil Zone at Santa Fe Springs Proved

Most recent developments in the western part of the Santa Fe Springs field indicate that no wells producing more than 6,000 or 7,000 bbl. may be expected in the future. The lower limits of the oil zone have been proved by finding edge-water 300 ft. below the top of the zone. The zone is hardly more than 300 ft. thick, instead of the 600 ft. established on the crest of the dome. Deep wells, even near the crest of the structure, are already affected by edge-water in the lower sands. The townsite is showing a marked decrease in gas pressure. It is thought that the partly drilled northwest end of the field will lose part of its gas by migration to the townsite. Because of these various elements, which none of the curves takes into consideration sufficiently, the final estimate of the daily average production for the Santa Fe Springs field is as follows: 1923—September, 344,000 bbl.; October, 320,000 bbl.; November, 287,000 bbl.; December, 252,000 bbl. 1924—January, 216,000 bbl.; February, 184,000 bbl.; March, 154,000 bbl.; April, 130,000 bbl.; May, 113,000 bbl.; June, 102,000 bbl; July, 92,000 bbl.; August, 82,000 bbl.; September, 72,000 bbl.; October, 62,000 bbl.; November, 52,000 bbl.; December, 42,000 bbl.

The three methods gave closer results for the Long Beach field than at Santa Fe Springs. With Method *A*, the following results were secured: September, 1923, 232,310 bbl.; October, 266,680 bbl.; November, 285,890 bbl.; December, 242,195 bbl.

In applying Method *B*, it will be noted that the daily average production per well for this field has continued uniformly at approximately 1,000 bbl. since last January. It will probably continue at this rate until November. By February, 1924, this will have declined to 800 bbl., and by May will be 530 bbl. The number of new wells has been assumed to increase regularly until 300 wells are secured in January, after which it was felt that new wells would only replace old wells lost. Judging by the number of wells that have dropped out the foregoing assumptions seem liberal. The results of Method *B* are as follows: 1923—September, 266,680 bbl.; October, 275,000 bbl.; November, 277,000 bbl.; December, 266,000 bbl. 1924—January, 246,000 bbl.; February, 230,000 bbl.; March, 200,000 bbl.; April, 174,000 bbl.; May, 147,000 bbl.; June, 121,000 bbl.; July, 94,000 bbl. In this field it was found that the production existing on the first of each calendar month declined during that month at the rate of approximately 10 per cent. The total daily new production each week has increased from 12,000 bbl. in February to 14,000 bbl. in May, to a peak of 25,000 bbl. in June, and has since declined to 14,000 bbl. in September.

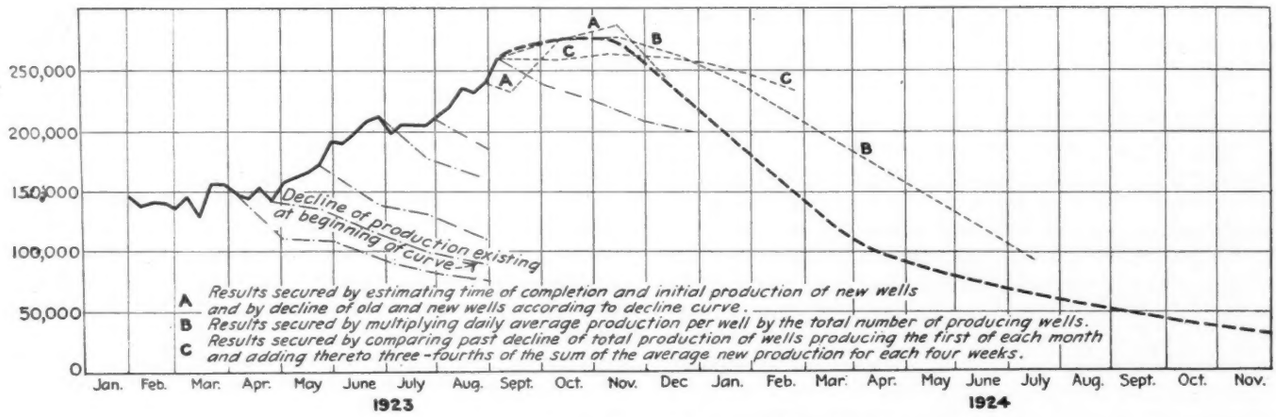
The number of new wells has varied from week to week, but six wells is an average figure per week. The average daily initial production for new wells in this field has risen irregularly from 2,600 bbl. in February to 3,400 bbl. in May, and 3,000 bbl. in July, and has since declined to 2,380 bbl. at the present time. This indicates that the daily average production for a new well will be about 2,200 bbl. in October, 1,300 bbl. in January, and 800 bbl. in March, 1924. Applying Method *C* to the above figures, the following results are secured: 1923—September, 258,000 bbl.; October, 257,000 bbl.; November, 263,000 bbl.; December, 259,000 bbl. 1924—January, 252,000 bbl.; February, 245,000 bbl.; March, 228,000 bbl.

Method *C* eventually rises above Methods *A* and *B*. This primarily is due to the fact that the old production, existing at the first of each calendar month, has declined very slowly, as wells have been partly shut in ever since spring. In the future, however, with the wells flowing wide open, old production will decline much more rapidly than it has in the past. When this condition does occur, and is applied in constructing a curve under Method *C*, the results may be much less than those shown by the *C* curve.

Deep Drilling Has Been Popular

The Signal Hill field has a remarkably thick oil zone, and protection against the infiltration of water has not been based on uniform shut-offs. Only one shut-off was necessary at the top of the oil zone. Edge-water has been avoided in the past by merely drilling deeper, cementing another string of pipe, and bringing in a well; but this cannot go on indefinitely. Eventually the field will have to pay for such practice. Water will be able to migrate from deep shallow wells to deep wells with shallow second shut-offs. This will cause a more rapid decline in old production than has been assumed, and may even result in destroying new production.

The desire to drill deep has existed in all of the fields, upon the theory that the deeper one drilled the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Decline of production existing at beginning of curve
A Results secured by estimating time of completion and initial production of new wells and by decline of old and new wells according to decline curve.
B Results secured by multiplying daily average production per well by the total number of producing wells.
C Results secured by comparing past decline of total production of wells producing the first of each month and adding thereto three-fourths of the sum of the average new production for each four weeks.
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov.
1923
1924

Well data and production for Long Beach field

better the production. At Huntington Beach this resulted in securing edge-water in the lowest sands of the zone. At Santa Fe Springs, even in the townsite, the same result was secured. At Signal Hill, the enthusiasm for deep drilling is still manifest by many. The operator who fails to get to the supposed bottom of the zone, because of the physical condition of his well, may eventually be more fortunate than his neighbor who bores his way down. All of these facts will tend to make the results outlined above under methods *A*, *B*, and *C* entirely too high. Every favorable factor that can give hope of increase has been considered. The only factors that remain are those that will lessen production. In view of this condition, it has been assumed that the daily average production of the field by months will be as follows:

1923	Bbl.	1924	
September	264,000	May	84,000
October	274,000	June	75,000
November	272,000	July	64,000
December	240,000	August	56,000
1924		September	48,500
January	205,000	October	42,500
February	171,500	November	36,000
March	128,000	December	31,000
April	101,000		

The Huntington Beach field rose in production from 80,000 bbl. in January to 125,000 bbl. in March. Thereafter part of its production was always shut in, so that the field has only produced from 100,000 to 125,000 bbl. per day. Under Method *A*, it would appear that production in the field would continue about 100,000 bbl. until November, but this conclusion is not supported by curves drawn under the other methods and by conditions in the field.

The average daily production per well for deep wells declined fairly regularly from 1,900 bbl. per day in February to 600 bbl. per day in September. This decline should continue in the same way until the wells reach the pumping stage, when it should be more gradual.

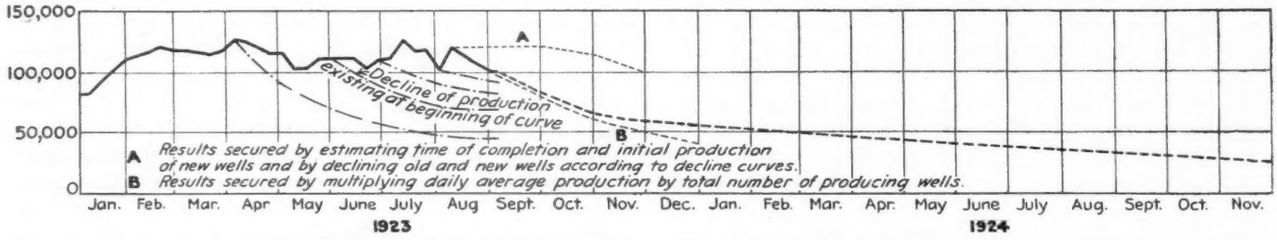
In the Huntington Beach field there are 66 shallower wells, producing from the Bolsa zone and the upper part of the Ashton zone, at a rate of about 10,000 bbl. per day. The curve under Method *B* was drawn on the deep wells, and then 10,000 bbl. per day was added to show the curve on the diagram.

Under Method *B* the expected production of the fields will decline by months as follows: September, 92,000 bbl.; October, 71,000 bbl.; November, 56,000 bbl.; December, 46,000 bbl.; January, 38,000 bbl.

Water in Huntington Beach Field

As this field is so nearly drilled up, and the character of the production that will be secured is uncertain, no attempt has been made to draw a curve under Method *C*. There are about 120 drilling wells in the field. Many of these are marginal wells in areas where small production and water trouble are to be expected. Those few deep wells that are drilling will have such a small new production that no credit has been allowed. The final curve for Huntington Beach should therefore be much like the decline of old production existing at the beginning of any calendar month, were it not for the fact that since March there has been shut-in production at Huntington Beach. In the future it is expected that all of this shut-in production will be released. The total production of the field will therefore decline even more rapidly than the old production existing at the first of each calendar month since April has declined in the past. Water troubles have already had their effect upon the Huntington Beach field, so that the final curve has not been reduced from the estimates to take this into consideration.

The situation at Huntington Beach is only a forerunner of the situation that will be had at Santa Fe Springs and Signal Hill. As the field was smaller, the effect of water and loss of gas has been less marked than it will be in the two other fields. Taking into consideration the elements bearing on Huntington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Decline of production existing at beginning of curve
A Results secured by estimating time of completion and initial production of new wells and by declining old and new wells according to decline curves.
B Results secured by multiplying daily average production by total number of producing wells.
Jan. Feb. Mar. Apr May June July Aug Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov.
1923
1924

Well data and production for Hungtington Beach field

Beach, the daily average production of the field has been estimated as follows:

1923	Bbl.	1924	Bbl.
September	94,000	May	44,000
October	75,000	June	42,000
November	63,000	July	38,000
December	58,000	August	35,000
1924	Bbl.	September	33,000
January	54,000	October	29,000
February	52,000	November	27,000
March	49,000	December	25,000
April	46,000		

The following table shows the actual and the estimated future production of these fields separately and added together for a total, during the years 1923 and 1924, the figures being in barrels:

Oil Production, Actual and Estimated, in 1923 and 1924

1923	Huntington Beach	Long Beach	Santa Fe Springs	Total
January	92,000	110,000	88,000	290,000
February	112,000	124,000	107,000	343,000
March	117,000	133,000	160,000	410,000
April	115,000	142,000	207,000	464,000
May	111,000	168,000	224,000	503,000
June	111,000	198,000	263,000	572,000
July	113,000	206,000	312,000	631,000
August	108,000	220,000	332,000	660,000
September	94,000	264,000	344,000	702,000
October	75,000	274,000	320,000	669,000
November	63,000	272,500	287,000	622,500
December	58,000	240,000	252,000	550,000
1924				
January	54,000	205,000	216,000	475,000
February	52,000	171,500	184,000	407,500
March	49,000	128,000	154,000	331,000
April	46,000	101,000	130,000	277,000
May	44,000	84,000	113,000	241,000
June	42,000	75,000	102,000	219,000
July	38,000	64,000	92,000	194,000
August	35,000	56,000	82,000	173,000
September	33,000	48,500	72,000	153,500
October	29,000	42,500	62,000	133,500
November	27,000	36,000	52,000	115,000
December	25,000	31,000	42,000	98,000

The results of the analyses made above may now be assembled and included in a single table of estimated production of California which is submitted for 1924. This shows a steady decline from 734,500 bbl. in January to 373,600 bbl. in December.

Petroleum Consumption Increasing

The only remaining element now to be considered is the question of consumption. During 1920 the consumption of the state rose from about 300,000 bbl. to 335,000 bbl. per day. During 1921 the consumption declined from 335,000 bbl. to about 245,000 bbl. at the time of the strike in October, but the year ended with consumption of 270,000 bbl. The year 1922 recorded an increase of consumption from 270,000 bbl. to nearly 450,000 bbl. During 1923 consumption has remained below 450,000 bbl., but well above 400,000, with a tendency to increase regularly. Consumption in August was 550,000 bbl. This was due to summer conditions. Many small refineries in Southern California placed all of their production on the market, making no attempt to store.

The consumption of oil during the next year will depend upon conditions generally in the West. California oil is used extensively in Arizona and Nevada in the copper industry. Railroads in the western states that considered giving up the use of fuel oil during shortage of a few years ago are now using it more extensively. Shipping on the Pacific is increasing. The many vessels built by the government during the war use fuel oil. The automobile industry has flourished.

Estimated Production of California for 1924

In Barrels

Field	January	February	March	April	May	June	July	August	September	October	November	December
Northern Fields												
Kern River	19,800	19,800	19,800	19,700	19,600	19,600	19,600	19,500	19,400	19,400	19,300	19,200
McKittrick	6,000	6,000	6,000	5,900	5,900	5,900	5,800	5,800	5,800	5,700	5,700	5,700
Midway-Sunset	81,000	80,700	80,300	80,000	79,700	79,301	79,000	79,600	78,300	78,000	77,600	77,300
Elk Hills	21,000	20,500	20,000	19,500	19,000	18,500	20,000	21,000	23,000	24,000	26,000	28,000
Lost Hills } Belridge }	4,800	4,600	4,500	4,400	4,200	4,100	3,900	3,800	3,700	3,600	3,400	3,300
Coalinga	30,000	29,700	29,400	29,200	28,900	28,700	28,400	28,100	27,900	27,600	27,300	27,100
Santa Monica	12,600	12,500	12,500	12,400	12,300	12,200	12,100	12,100	12,000	11,900	11,800	11,700
Summerland	150	150	150	150	150	150	150	150	150	150	150	150
Watsonville	50	50	50	50	50	50	50	50	50	50	50	50
Wheeler Ridge	300	300	300	300	300	300	300	300	300	400	400	400
Totals	175,700	174,300	173,000	171,600	170,100	168,801	169,300	170,400	170,600	170,800	171,700	172,900
Southern Fields												
Newhall and Ventura	11,300	11,500	11,700	11,800	12,000	12,200	12,300	12,500	12,700	12,800	13,000	13,200
Salt Lake	2,400	2,300	2,300	2,300	2,300	2,300	2,200	2,200	2,200	2,200	2,200	2,100
Los Angeles	600	600	600	600	600	600	600	600	600	600	600	600
Montebello-Whittier	15,700	15,400	15,100	14,900	14,700	14,400	14,200	13,900	13,600	13,300	12,100	12,800
Coyote	18,100	17,900	17,900	17,700	17,600	17,500	17,400	17,300	17,200	17,100	17,100	17,000
Fullerton	11,700	11,500	11,400	11,300	11,200	11,100	10,900	10,700	10,600	10,400	10,300	10,100
Richfield	15,000	14,700	14,400	14,100	13,800	13,500	13,200	12,900	12,600	12,300	12,000	11,900
Huntington Beach	54,000	52,000	49,000	46,000	44,000	42,000	38,000	35,000	33,000	29,000	27,000	25,000
Signal Hill	205,000	171,500	128,000	101,000	84,000	75,000	64,000	56,000	48,500	42,500	36,000	31,000
Santa Fe Springs	216,000	184,000	154,000	130,000	113,000	102,000	92,000	82,000	72,000	62,000	52,000	42,000
Torrance-Redondo	8,000	9,800	11,300	12,500	14,300	15,800	17,300	18,000	20,300	21,800	23,300	25,000
Compton	1,000	1,000	1,000	3,000	3,000	2,500	2,500	4,000	4,000	6,000	8,000	10,000
Torals	558,800	492,200	416,700	365,200	330,500	308,900	284,600	265,100	247,300	230,000	213,600	200,700
Total Northern and Southern Fields	734,500	666,500	589,700	536,800	500,600	477,701	453,900	435,500	417,900	400,800	385,300	373,600

Daily Average Petroleum Production for California—Actual and Estimated for 1924

In Barrels

Year	January	February	March	April	May	June	July	August	September	October	November	December
1920	274,510	275,928	276,875	276,148	278,853	272,908	274,576	289,853	304,218	305,146	310,734	322,658
1921	325,410	328,104	338,544	338,992	336,941	337,045	329,844	323,227	261,980	227,865	293,616	325,631
1922	313,472	323,585	330,663	339,536	359,554	357,731	374,138	382,221	406,838	432,885	467,851	497,639
1923	530,885	586,670	632,522	689,865	694,689	755,570	814,906	877,976	900,807	867,807	821,307	748,807
1924	734,500	666,500	589,700	536,800	500,600	477,701	453,900	435,500	417,900	400,800	385,300	373,600

Daily Average Petroleum Consumption for California—Actual and Estimated for 1924. (Less Shipments Through the Panama Canal)

In Barrels

1920	303,886	307,809	312,446	290,624	295,551	311,773	304,425	320,902	313,371	324,620	311,868	333,399
1921	315,403	317,401	294,982	305,216	254,476	277,370	273,185	253,824	268,689	247,677	296,443	273,694
1922	273,499	303,977	284,945	271,487	287,447	306,186	318,167	298,999	340,601	390,609	395,021	451,503
1923	447,229	417,107	437,228	428,950	471,602	443,428	419,874	549,276	439,500	440,650	441,800	442,950
1924	444,100	445,250	446,400	447,550	448,700	449,850	451,000	.....	.....	.....	.....	.....

It seems reasonable to assume that all of these industries are on a substantial basis and that their trend is upward. They should use more oil.

Neglecting the sharp increase in consumption of August, and assuming a gradual change, it appears that consumption will increase regularly from 440,000 bbl. in September, to 450,000 bbl. for July, 1924. At that time, and at that amount, consumption will equal production. There will be no more oil for storage and no more oil for shipment through the Panama Canal without drawing on the oil that will have been placed on storage up to that time. Thereafter consumption should continue at about 450,000 bbl. per day, while production should decline regularly.

Tabulations of the production and consumption from 1920 to 1924 inclusive are shown in the table on the preceding page.

When it appears evident next spring that production will probably fall below consumption, it is highly probable that the development of the new fields at Torrance, Compton, and Wheeler Ridge will be speeded up during the spring and summer of 1924, to take care of the deficiency. Should this be done, the estimates herewith will not be realized.

The outlook for the future is definite enough, however. Visitors from the East who have come to study conditions in California may return home with a more optimistic feeling that the end of overproduction in California will come within the next year. Those at home may well conclude that the heavy load now being carried by the oil industry will be reduced in another six months. The public generally perhaps does not appreciate that those organizations exerting themselves to store and retain oil in California are performing a genuine public service for the state, since that oil will be needed before the close of 1924.

Drilling for oil under Point Firmin at San Pedro, California

California Oil-field Operations in October, 1923

Figures giving the production of petroleum and the amount of development work done in the California oil fields in October have been issued by the Pacific Coast office of the American Petroleum Institute, as set forth in the following tables:

California Petroleum Production in October

District	Barrels per Month	Daily Average October, 1923	Daily Average September, 1923
Kern River	465,599	15,019	19,002
McKittrick	193,532	6,243	6,070
Midway-Sunset	2,298,350	74,140	74,645
Elk Hills	714,976	23,064	22,987
Lost Hills-Belridge	109,314	3,526	3,792
Coalinga	426,611	13,761	14,198
Wheeler Ridge	14,154	456	509
Watsonville	1,783	57	58
Santa Maria	248,255	8,008	8,161
Summerland	4,513	146	146
Ventura-Newhall	304,889	9,835	10,090
Los Angeles-Salt Lake	101,297	3,267	3,095
Whittier	51,423	1,659	1,668
Fullerton	330,262	10,654	11,291
Coyote	61,857	1,995	2,558
Santa Fe Springs	8,004,471	258,209	314,662
Montebello	318,244	10,266	10,490
Richfield	464,645	14,988	16,169
Huntington Beach	2,445,809	78,897	89,628
Long Beach	7,580,339	244,527	240,918
Torrance (Redondo)	394,395	12,722	7,417
Compton	41,682	1,345	1,193
Total	24,576,400	792,787	858,750
September	25,762,487	858,750	.....
Decrease	1,186,087	65,963	.....

Field, Refinery, Pipe Line, and Tank Farm Stocks of Crude, Residuum, and Tops

	Barrels	Barrels
Heavy crude, heavier than 20 deg. A.P.I., including residuum at Sept. 30, 1923	42,413,027	
Refinable crude, 20 deg. A.P.I., and lighter, at Sept. 30, 1923	31,584,259	
Tops at Sept. 30, 1923	11,499,323	
Total stocks at Sept. 30, 1923		85,496,609
Heavy crude, heavier than 20 deg. A.P.I., including residuum at Oct. 31, 1923	42,585,664	
Refinable crude, 20 deg. A.P.I., and lighter, at Oct. 31, 1923	33,659,232	
Tops at Oct. 31, 1923	12,104,654	
Total stocks at Oct. 31, 1923		88,349,550
Stock increase, October		2,852,941
Total quantity of above products held at refineries Oct. 31, 1923		28,222,460
Total field, pipe line and tank farm stocks at Oct. 31, 1923		60,127,090
Total stocks at Oct. 31, 1923, as above		88,349,550
Total stocks at Sept. 30, 1923, as above		85,496,609

Development

District	New Rigs Up	Active Drilling	Completed	Daily Initial Output	Active Producing	Abandoned
Kern River	1	1	..	.....	1,778	..
McKittrick	...	6	..	.....	283	1
Midway-Sunset	14	49	10	3,022	2,142	..
Elk Hills	3	9	1	2,500	90	..
Lost Hills-Belridge	...	2	..	.....	246	..
Coalinga	...	6	..	.....	677	4
Wheeler Ridge	1	9	..	.....	5	..
Watsonville	...	...	..	.....	6	..
Santa Maria	...	3	..	.....	327	1
Summerland	...	...	..	.....	135	..
Ventura-Newhall	4	31	..	.....	541	1
Los Angeles-Salt Lake	...	...	..	.....	634	..
Whittier	...	...	..	.....	174	..
Fullerton	...	4	..	.....	384	..
Coyote	...	4	..	.....	94	..
Santa Fe Springs	7	159	29	54,872	247	5
Montebello	...	6	..	.....	121	..
Richfield	...	8	1	75	175	1
Huntington Beach	2	79	10	4,245	222	7
Long Beach	3	216	36	53,909	289	9
Torrance	51	82	12	9,135	46	..
Compton	5	12	..	.....	1	..
Miscellaneous drilling	3	59	..	.....	.....	4
October	94	745	99	127,758	8,617	33
September	104	805	93	139,960	8,922	37
Decrease	10	60	6(a)	12,202	305	4
Average for year 1922	115	605	67	43,700	9,410	17
Average for year 1921	90	536	57	15,631	9,425	14
Average for year 1920	77	403	49	14,125	9,299	13
Average for year 1919	58	340	47	9,572	8,774	18
Average for year 1918	50	362	50	10,577	8,210	13

(a) Increase.

Mining Camps of North America

Charcas, an Ancient District in San Luis Potosi

One of the Famous Silver Camps That Disgorged Millions of Ounces in the Sixteenth and Seventeenth Centuries—No Doubt Much Remains Below the Water Level—Mina Tiro General Produces Regularly

By Charles Leighton Bradbury
Formerly Assistant Engineer, Charcas Unit, National Metallurgical Co.

Charles L. Bradbury

THE STATE of San Luis Potosi lies in the central part of Mexico. In days long past it was the scene of great mining activity, and for many years was the greatest mining region in Mexico, containing within its boundaries the famous camps of San Pedro, Guadalcazar, Catorce, Matehuala, Charcas, and numberless isolated mines scattered over the entire state.

It is a country of limestone and extensive volcanism. Flung athwart the desert plateau, 7,000 ft. above sea level, serried ranges trending north and south traverse the Mesa Central. The mountains are composed principally of upturned blocks of limestone. From their talus slopes, stretching away in vast catenaries to riverless valleys, the bolsons are covered with caliche. Vegetation is scant. Brilliantly green against the alabaster background, scrub palms and nopal cactus dot the countryside.

The town of Charcas is situated about sixty miles north of the city of San Luis Potosi, and about seven miles west of the main line of the National Railways of Mexico, to which it is connected by the Ferrocarril Central de Potosi, a spur railroad owned by the American Smelting & Refining Co., through its subsidiary, the National Metallurgical Co., the principal operators in the district at the present time.

Mining Dates Back to Sixteenth Century

Charcas is a most interesting relic of early vice-regal times. It was founded in the year 1574 by Don Juan Oñate de Cortez, a grandson of the Conquistador. Toiling across the desert plateau in command of a party of Spaniards exploring this region, he discovered the rich croppings of several veins, which were even at that early time being worked for their silver by the Chichimeco and Zacateco Indians, who inhabited the surrounding country. Don Juan took possession of these mines in the name of the Spanish Crown, and founded the city of Charcas, which was soon to become the seat of the local government. It is probable that the Spaniards who explored this region came northward from Bolivia, as the name of the state—Potosi—is said to have been taken from the famous silver bonanzas at Potosi in Bolivia. It is possible that Charcas was named after the capital city of Bolivia, which formerly bore that name.

Soon after Charcas was founded it was destroyed by the Indians, who were unusually fierce and warlike. It was immediately rebuilt, and the discovery of many new veins gave an impetus to its growth which carried it into the front rank of Mexican mining centers, and kept it there for two centuries, until it was eclipsed by the phenomenal discoveries of horn silver at Catorce, about fifty miles northward, about the year 1780.

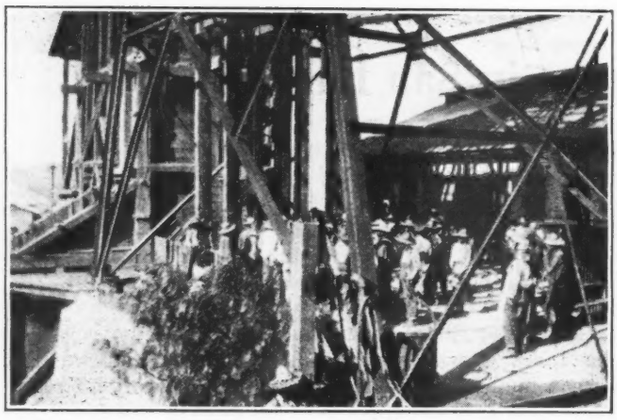
A large patio-process plant was built at Charcas, which today is crumbling to dust, but which bears silent testimony of the magnitude of the mining operations during the sixteenth and seventeenth centuries. Over the entrance of an ancient hostelry in Charcas the arms of Cortez can still be faintly discerned. Many of the rancheros living near Charcas today bear that illustrious name.

Although silver has always been the principal product of the Charcas mines, the production of "magistral" was an important industry during the days of the patio process. A number of the veins in the district contain cupriferous pyrite. This was roasted, and the resulting product, called magistral, was shipped to many points in the State of San Luis Potosi and to mining centers in neighboring states. Magistral, or, strictly speaking, the sulphate of copper contained by it, was one of the principal reagents of the patio process.

Work at a Standstill During the Revolution

During the time of President Porfirio Diaz, before the revolution of 1910, Charcas was a community of over 8,000 inhabitants, most of whom were descendants of the Chichimeco and Zacateco Indians, with a considerable admixture of Spanish blood. There were, and still are, a few families in Charcas of pure Spanish blood, some of whom are descended from the founders of the city. During the long years of the revolution the population dwindled to less than 2,000. Many of those who stayed had nothing to eat except such small game as they could snare, a little corn and beans, and some dishes ingeniously prepared from parts of different cacti.

During the summer of 1922, the Mina Tiro General, as the property of the National Metallurgical Co. is known locally, began to put on men. There had been no mining in the district since 1913, except for a short-lived period in 1918. Half starved and ragged, hundreds of peons clamored for work. At present, with 700 of its men working in the Mina Tiro General, and 150 in the Mina La Bibiana, a Mexican enterprise, prosperity has returned to Charcas. On Sundays and holidays the plaza (a plaza is indigenous to all Mexican towns) is filled with people who seem happy and carefree. Scores of cantinas dispense mescal, sotol, and tequilla; there are numbers of stores, and a moving picture show; once or twice a month there is a bull fight in the ancient Plaza de Toros. A company of



Mexican miners waiting to go underground at the San Fernando shaft

well uniformed and equipped federal soldiers is quartered in the town. The civil police function independently of the soldiery. They may occasionally be observed bearing away some struggling unfortunate to the Jusgado.

The peon—utterly poor, living in a rude jacal of sticks and thatch, or a hut built of stones, wearing leathern sandals, a breech clout, a two-gallon straw hat, with a serape flung over his shoulder, and a cigarette rolled in a corn husk between his lips—certainly has changed but little with the passing of the centuries.

Labor Legislation Is Stringent

The State of San Luis Potosi has recently enacted some rather stringent legislation pertaining to employer and employee. One law now rigidly enforced prevents discharging men without three months' pay. Another provides for the payment of relatively large amounts of money to the families of men killed or disabled in mine accidents. The bitter lessons seared into the memories of the people by nine years of revolution and starvation are still fresh; they know that if the mines shut down, their lot will be hard.

Country Rock Is Limestone

The mining district of Charcas covers an area of about twenty-five square miles on the slopes of the Sierra de Charcas, a low range which rises less than 1,000 ft. above the surrounding plateau. There are perhaps 100 shafts in this circumscribed area, few of which have been worked for a great many years.

The Sierra de Charcas consists principally of limestone, which has been classed as Cretaceous by the Mexican Department of Mines. It varies in color from blue to gray, contains few fossils, and is quite free of impurities. The thickness of this series of limestones is something under 2,000 ft., although to a casual observer it might appear to be two or three times that figure. There is a great amount of duplication of beds caused by intense folding, producing closed anticlines from which the upper arched portions have been eroded. Some of the most remarkable exhibits of folding and faulting are to be seen along precipitous canyons which cut these beds. Much of the limestone has been metamorphosed into marble.

The dynamic agencies which produced the Sierra de Charcas were of two distinct kinds: first, the ordinary lateral stresses, common to this region of uplift, folded and crumpled the previously horizontal beds into several parallel ranges, of which the Sierra de Charcas is the highest. Before this orogenic era came to a close, an intrusion of granite-porphyry welled up under the broken and weakened crust of limestone and intruded it freely. At the present stage of erosion there are at least a dozen different lines of contact between the limestone and the porphyry exposed at the surface. This granite-porphyry is of light color, highly acidic, and consists principally of quartz and orthoclase, with traces of micas and the dark minerals.

Large Mineralized Area

The western slope of the Sierra de Charcas is a steep fault escarpment. Stretching away to the west for a distance of five miles from its base in an area covered by a red extrusive rock, probably rhyolite. The rhyolite covers a series of shales and slates of unknown thickness. To the west of this area of extrusives an eastward facing escarpment of limestone similar to that of the Sierra de Charcas parallels that range.

Much of the area included in the Charcas mining district is intensely mineralized. The greatest number of veins, and the most important ones, lie along or near the limestone-porphyry contacts in the eastern part of the district.

In the rhyolite area previously referred to there are

View of the San Fernando surface plant from the Tiro General shaft

three important parallel veins, which pass downward through the rhyolite, through the shales and slates, to an unknown depth and an unknown basement. The deepest workings on these veins are about 900 ft. below the surface, in the San Diego mine.

In the southern part of the district there are several veins of moderate size near small basic dikes which traverse the limestone. These are the youngest veins of the district. Many of them contain appreciable quantities of arsenic and antimony. One of these veins several feet in width outcrops in a stream bed at the bottom of a deep canyon, and is called by the natives la Veta Pestosa (the stinking vein), because of sulphurous and arsenious odors which emanate from it. It has never been prospected in depth, because of its position in a water-course.

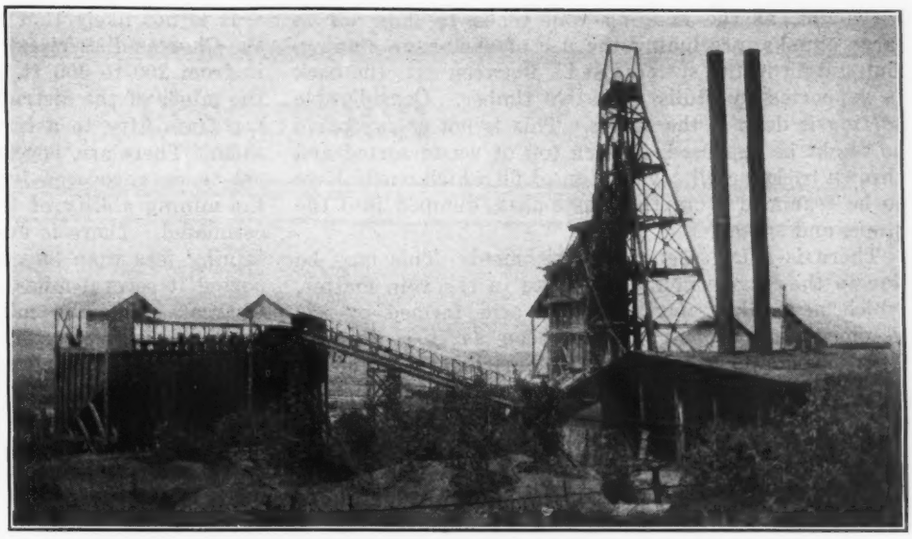
The veins which are localized near the limestone-porphyry contacts in the eastern part of the district are not contact-metamorphic deposits, but occupy fissures which were formed at some period after the intrusion by the contraction of the magma as it cooled.

These fissures were filled by mineralizing solutions which were perhaps the final products of the cooling intrusion. The vein matter of these deposits is typically calcite and quartz, with sulphides of iron, zinc, and occasionally lead and copper. All of these contain silver.

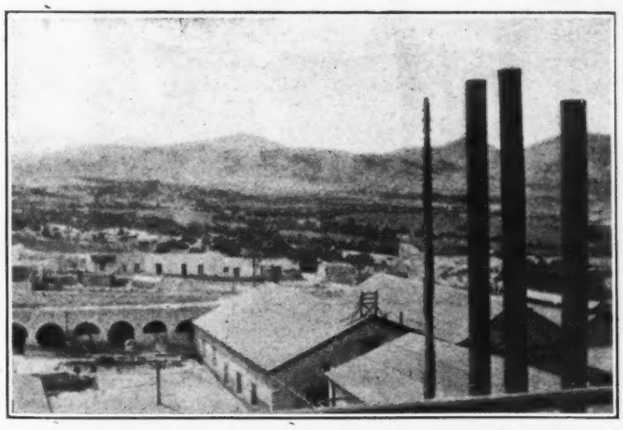
There is much zinc in the veins throughout most of the district. Zinc has not developed into economic importance as yet, although it has been said, perhaps facetiously, that the Mina Tiro General is the greatest zinc mine in Mexico. This statement may have been made by some chagrined superintendent of bygone days as he looked over his smelter settlement sheets and "viewed with alarm" the penalties exacted for the zinc content of his ore. The La Bufa mine, situated half a mile west of the Mina Tiro General on the same limestone-porphyry contact, was originally worked for silver, but high-grade zinc ore was encountered at depth. This property was taken over by the Empire Zinc Co., which has maintained watchmen on it ever since it was shut down, together with the other mines of the district, when insurrectos brought war to Charcas in 1913. The Trinidad mine, which is situated between La Bufa and the Mina Tiro General, has produced much gold. This is extraordinary, as gold is found nowhere else in the district except in minute quantities, with silver.

The Mina Tiro General is the largest mine in the district. It lies along the northernmost limestone-porphyry contact. It has been worked continuously, with many short interruptions, since the sixteenth century, and has an imposing production record.

The oreshoot is about 1,400 ft. long, and is worked through two shafts, the Tiro General at the western end, and the San Fernando at the eastern end. The former is about 1,400 ft. deep and the latter, 1,200 ft. At the surface the vein splits and diverges about halfway between the two shafts, forming a "Y." The stem of the Y is called the combination lode; the southern prong, on the limestone side of the contact, is called the Leones vein, and the northern prong, on the porphyry side, is called the Santa Isabel vein. The two branches converge in depth also, uniting about 700 ft. below the surface. Below the junction the vein is from 20 to 50 ft. in width, averaging about 35 ft. The dip varies from 70 to 80 deg. to the north. These two veins occupy the principal fissures along the limestone-porphyry contact, which were caused by the contraction of the porphyry along horizontal radii. Two smaller veins, which strike along the principal lode, dip off to the south into the limestone at about 40 deg. These flatter veins occupy fissures which were produced in the limestone by the contraction of the adjacent porphyry along vertical radii.[1]



Headframe, hoist house and sorting bins at the San Fernando mine



Tiro General power house and patio, with the Sierra de Charcas in the background

The upper levels of the mine were worked many years ago through numbers of shafts, by various owners. The drifts in these levels are lined with masonry, composed of blocks of caliche and mortar. Some of these drifts are undoubtedly several centuries old, and many are in as good condition as when they were driven. Near the shaft on the first level there is a chapel, where the peons of other days, more pious than their descendents, worshiped. These old workings are very irregular. All mining was done by drilling "down" holes by hand. The broken ore was gathered up in baskets and skins, and transported to the shaft, or in many instances, to the surface, through spiral inclined passageways, on the backs of peons.

Mining operations are at present confined to that part of the vein below the sixth level, 700 ft. below the surface. The vein matter does not exhibit the regular banded structure, and is most capricious as to richness. Along the footwall there is a uniformly good streak of ore from 1 to 15 ft. wide, but from the edge of this streak to the hanging wall the closest sampling is necessary, as ore is interspersed with barren gangue without any regularity. Streaks of good ore may parallel the walls, or form sharp angles with them. many kidneys of ore are found entirely surrounded by barren material. Near the vein the limestone is highly silicified and impregnated by small amounts of sulphides, averaging about 1 per cent sulphur for a distance of 100 ft. from the vein.

On the hanging-wall side the porphyry is of aphanitic texture near the vein, and contains many small veinlets, a most unfortunate circumstance from the miner's

[1]See J. E. Spurr, "The Ore Magmas," Vol. I, p. 289, Fig. 59.

viewpoint, as the hanging wall tends to flake off in large chunks, precluding the use of shrinkage stoping. Cut-and-fill is the system used. Between cuts the back is supported by stulls of native timber. Considerable sorting is done in the stopes. This is not as expensive as might be supposed, as each ton of waste sorted and thrown back for fill saves a ton of fill which would have to be trammed from the waste-pass, dumped into the stope, and spread.

There is little secondary enrichment. This may be due to the large amount of calcite in the vein matter, which neutralizes any sulphuric acid formed by the decomposition of sulphides as soon as it is formed. There is, however, one form of enrichment of importance. Throughout the veins there are numerous "slips" and gouge areas which have been partly oxidized even as deep as the tenth level. Some of the gouge is rich in silver, although much of it is barren. This silver was leached and carried downward by waters moving along the fault planes and deposited below.

There is no concentrator at Mina Tiro General at present. The ore is shipped to smelters at Aguascalientes and Matehuala after hand sorting on conveyor belts, which eliminates about 7.5 per cent of the rock. There have been two mills on the property within the last thirty years, one a wet concentrator and the other a dry mill with dielectric separators designed to remove the zinc.

Few records are available of the other mines in the district, with the exception of La Bufa, previously mentioned, and the San Diego, which was opened to the depth of 900 ft. This mine, after a very long life and a large production record, was closed in 1904, when a heavy flow of water was encountered. For its entire life it was operated without any concentrating plant. After hand-sorting to remove quartz from the highly siliceous vein matter, the ore was carted fifteen miles to the railway and shipped to smelters. It is reported that a large company has recently become interested in this property.

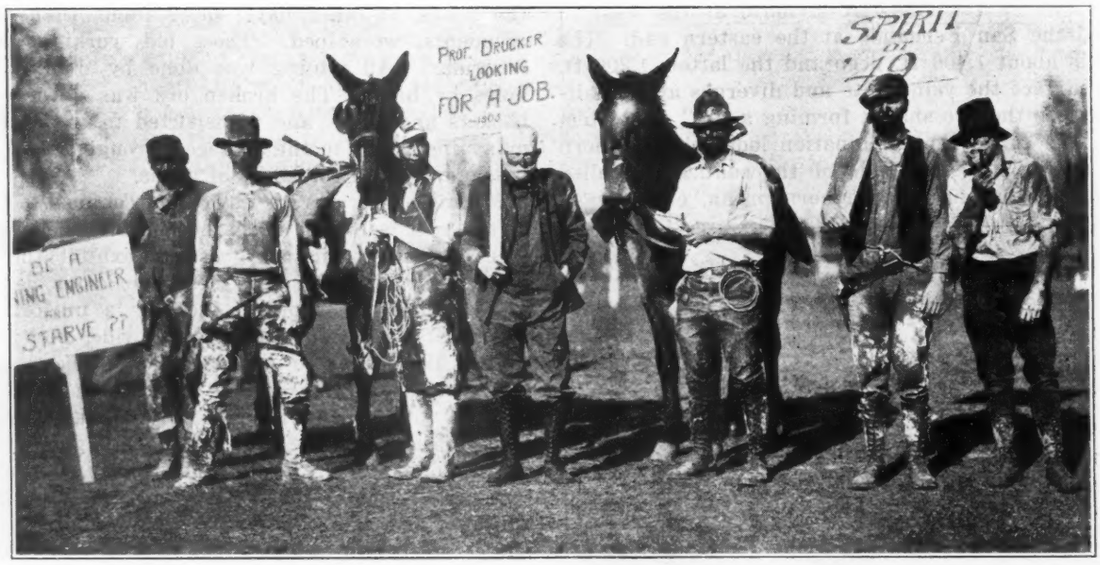
It is not likely that any of the ancient workings of the Charcas district extend far below water level, which is from 200 to 300 ft. below the surface. As most of the mines of the district have not been actively worked for from fifty to a hundred years, little is known of them. There are, beyond doubt, large quantities of ore yet to be uncovered in the Charcas district, although the mining ability of the ancients is not to be underestimated. There is evidence that they mined ore containing less than 30 oz. of silver per ton, and transported it several miles on burros to the patio plant at Charcas. Splendid miners as they were, they could not cope with water. The future of the Charcas district lies below the water table.

Considerable mining was being done in the district by independent American and Mexican operators when the revolution put a stop to all mining activity in 1913. Attacked by insurrectos, the staff of the Mina Tiro General escaped on a locomotive, after a short siege, during which more than twenty of the attackers were killed.

Smelter at San Luis Potosi May Help District

Among mines of the Charcas district which have been large producers in the past are the Moctezuma Copper, Santa Elena, Bibiana, Morelos, San Carlos, Hormigos, Guadalupe, Potosi, San Augustin, Trinidad, Santa Eulalia, San Diego, and San Sebastian. Among the small mines and prospects may be mentioned the Denver, Oriental, Alarcan, Las Fortunas, Anaconda, Cuahtemoc, Buena Fe, San Emilio, Cuprita, Esperanza, Plomosa, and Santa Monica.

With the reopening of the smelter at San Luis Potosi, which was recently taken over by the American Smelting & Refining Co. from the Compania Metalurgica Mexicana, the freight rate from the Charcas district to the smelter will be considerably reduced, as San Luis Potosi is only sixty miles south of the district, whereas Aguascalientes, to which most of the Charcas ore is shipped at present, is three times as far.



Senior mining students at the University of Illinois made a hit with their imitation of a bunch of early-day prospectors in this year's "Hobo Parade," which is a feature of the University's annual "Homecoming"

DISCUSSION

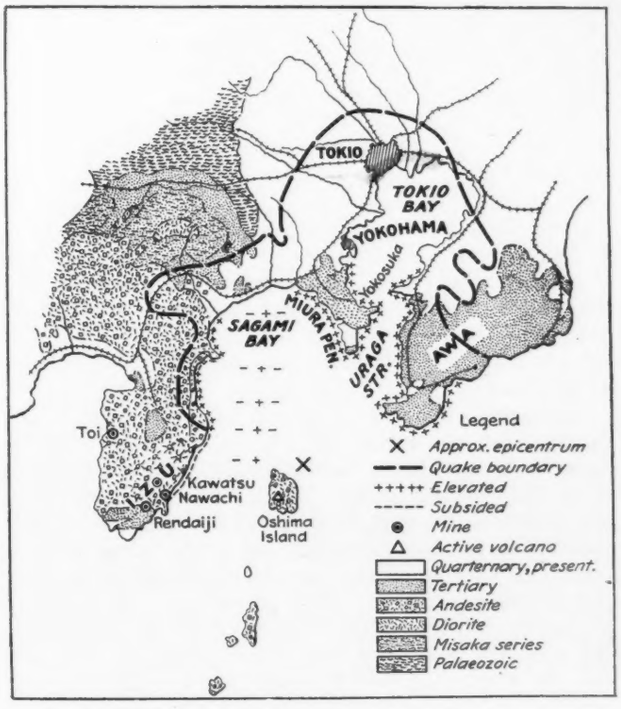
"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

The Earthquake and Fire in Tokio

THE EDITOR:

Sir—The result of the earthquake and the fire that swept Tokio and Yokohama is too horrible to describe. I now wish to express, with the rest of the Tokio citizens, my thanks to the citizens of the United States for their deep sympathy shown and invaluable relief work being done since the disaster. At present I can write only about what is said, and I may be excused from going into any further detail. Dr. T. A. Jaggar is here, and has been making thorough investigation in the quake-affected area. Before long you will surely hear from him of his authentic view based on his professional inquiry into the subject.

The great earthquake and fire of Tokio that made the world's record of destruction broke forth on Sept. 1, 1923, or to be exact at 11:58 a.m. According to the record it may be compared with the last disastrous



Geological map of area affected by earthquake. Cross shows center

earthquake and fire of Tokio, or Edo as the town was called then, on the night of Oct. 2, 1855, but damage done by the fire this time is greater by far.

The origin of the earthquake has not as yet been satisfactorily determined. Scientific investigation has since been carried on by the seismologist and geologist of the university and the Central Weather Bureau, and the final conclusion as to its origin, extent, and nature and all other detailed information will be made public before long. Dr. T. A. Jaggar, of Honolulu, is visiting the affected area. His authentic report is anticipated with much interest.

The epicentrum was determined by means of the instrument to have been in the bottom of the sea near

Fissures in street in business district, Yokohama

Oshima Island. The first shock felt in Tokio was so intense that all the reliable seismographs at the Imperial University and the Central Weather Bureau were put out of service. The amplitude is said to have been five inches. In Tokio the vertical movement was followed by horizontal vibrations of a long duration, whereas in Yokohama, being nearer to the epicentrum than Tokio, the first up-and-down movement was much greater than the horizontal.

The wholesale destruction of Tokio is ascribed to the sweeping fire that broke out from many sections in the downtown district right after the first shock. Twenty minutes later another but less intense shock was felt in Tokio, followed by many lesser ones. A record of frequency up to Oct. 4 is given below:

Earthquake Shocks Recorded in Tokio, Sept. 1-Oct. 4, 1923

Date from Noon to Noon	Number of Quakes	Date from Noon to Noon	Number of Quakes
Sept. 1–2	356	Sept. 18–19	2
2–3	289	19–20	5
3–4	173	20–21	6
4–5	143	21–22	4
5–6	63	22–23	4
6–7	45	23–24	0
7–8	43	24–25	2
8–9	36	25–26	5
9–10	30	26–27	9
10–11	19	27–28	5
11–12	17	28–29	1
12–13	12	29–30	4
13–14	15	30–Oct. 1	2
14–15	11	Oct. 1–2	2
15–16	6	2–3	10
16–17	5	3–4	3
17–18	7		

The epicentrum seemed to have moved toward the north and northwest, as observed in Tokio by the change in the course of vibrations from a north-south direction during the first ten days to a northeast-southwest direction later on. The naval authority and marine organization have already made a general submarine survey, and is reported to have found a great change in the depth of Sagami Bay. The result of recent soundings revealed a surprising fact that general fault lines seem to run in a north-south direction and that the subsidence with respect to the former sea bottom amounts to 100 fathoms and the upheaval to 50 fathoms.

Street car tracks cut off by earth movement, Yokohama

The coast line of Miura Peninsula has risen on an average 4 ft. and that of Awa Peninsula across Uraga Strait resulted in an upheaval of between 3 and 6 ft. As seen from the map on p. 1035, Tokio was the farthest from the epicentrum, and the shocks felt there must have been the least violent of all those felt in the affected districts and especially much less than those in Yokohama. It was the fire rather than the earthquake that was responsible for the wholesale destruction of Tokio. The Bureau of Relief Work reported the following:

Up to Sept. 12, 1923	
Number of houses destroyed by the fire	289,846
Number of houses tumbled down by the quake	15,942
Number of persons killed in the fire	74,024
Number of persons wounded	39,767

Fortunately there is no mine situated within the affected area, and those gold mines in the southeastern part of Izu Peninsula, such as the Rendaiji and Kawazu mines, are reported to have suffered no damage. The Toi gold mine, which is situated on the northwestern shore of the peninsula, is said to have been practically unaware of the great earthquake, and all the underground as well as the surface workings went on as usual.

In connection with this disastrous earthquake and fire I regret very much to be compelled to report the loss of an American engineer, Mr. Chester W. Purington, 168-B, Yamashita-Cho, Yokohama. The last I saw him was July 28, when he told me that he was going to the northern part of Japan and would meet me in Tokio in the early part of September. I thought and at the same time I wished that he was still in Hokkaido or somewhere on his inspection trip. A list of dead in Yokohama was posted at the American Embassy here, and in it I found name, C. F. Purington. The initial "F" in place of "W" left me a little encouragement to make further effort to make inquiry after him, and twice I tried a police station in Yokohama, but so far I could not get any definite information regarding him.

Mr. Purington came to Japan with his family in February, and made his happy home in Yokohama. He was the representative of a firm called the Ayan Corporation, and was associated with Mr. Hans Hunter, president of Taio Gold Mining Co. Mr. Purington had been actively engaged in the extensive exploration of certain gold placers in Okhotsk, and of late he has been showing much interest in gold and platinum placers in our Hokkaido. He had recently examined several gold and copper mines in Japan and must have had a number of unfinished reports on his examined mines. He was a hard worker, as all American engineers are. His genial smile is still in my vision and his firm and kind handshake still retains bodily warmness within my hand. My association with him lasted only half a year, but it will remain with me as long as I live as the most instructive and interesting time I have had in my life. His death is a great loss to the mining world at large as much as it is to our undeveloped mining country, in which his residence has meant invaluable service, but alas! he is no more.

HIRONAO NISHIHARA.

Tokio, Japan.

Summarizing Mining Reports

THE EDITOR:

Sir—With reference to the article on "An Analytical Method of Summarizing Mining Reports," in the issue of the *Journal-Press* of Oct. 27, 1923, and the use of a "critical value" to determine where profits begin, the figures given in the summary of production costs (page 714) are not clear.

If the average value of the ore available (100 tons per day) is $17.20 and the total production cost, including all charges, taxes, and losses, amounts to $14.39, then the margin for profit is $2.81 and not $1.71, as stated. It may be a coincidence that the difference of $1.10 is equal to 11 per cent of the f.o.b. railroad cost R and equivalent to the assumed metallurgical loss. Though the average stockholder may agree that figures cannot lie, he expects them to add up, unless he is to entertain the gravest suspicions regarding this matter of $1.10.

As a principle the inclusion of metallurgical loss in the cost of marketing (M) is open to criticism because it obscures a factor of the greatest influence upon the working profit. The complicated calculations and formulas given in steps 2c and 3b would be, I think, avoided if the metallurgical loss were calculated and inserted in terms of cost per ton of available ore f.o.b. rail directly after R. This would give the cost of producing marketable concentrate of the grade yielding the greatest profit per ton of ore available. To this cost the marketing cost M could then be added, obtaining it from the true marketing cost per ounce of silver sold which can be checked without difficulty.

Though the summary furnished provides the client with a clear statement upon the financial prospects, the appearance of mathematical accuracy obtained would tend to cover the approximations and estimates upon which a mining report is based and to that extent mislead the client.

L. C. STUCKEY.

Bilbao, Spain.

Screen Analyses by Hydrostatic Separation

THE EDITOR:

Sir—The article by Sergio Bagnara which appeared in your July 14 issue purports to show how, by a combination of screening and heavy-liquid separation, the proportion of middling in a crushed ore may be calculated, middling being defined as particles of ore in which the mineral and rock are still attached to one another. A method of obtaining this information would without question be of value; but after a careful study of the article I fail to see that the author has disclosed one.

In the first place, the curves obtained are non-mathematical and reference to the calculus only serves to cloud the issue; and the suggestion that approximate methods of arriving at certain relations must be employed cannot be accepted as an excuse for serious inaccuracies.

To capitulate briefly, the method given is to separate the crushed ore into fractions by screening, separate the sink and float in each size by methylene iodide, and obtain the ratio between the percentage of ore remaining on any particular screen and the percentage of sink in that portion, both percentages being calculated on the weight of the original sample. This ratio is termed the ratio of homothety; it varies from screen to screen, but according to Bagnara the ratio tends to become constant as screen sizes become smaller—that is, with no arithmetical difference between ratios corresponding to successive screen sizes; and when this condition is attained it indicates that at such screen sizes all the mineral is free; and, moreover, that arithmetical differences between successive ratios are the expression of the percentage of middling in material lying between corresponding screen sizes, and that these percentages may be summed to obtain the percentage of middling in the sample. It is evident from a later paragraph that the amount of middling so calculated is that existing in the sink only, because a different method of obtaining that in the float is given, with the suggestion that the two be summed to obtain the total middling. If the former method gives accurate or even approximately accurate results on the sink, why should it be inapplicable to the float? But if it is so applied, the amount of middling in the float is found to be exactly equal to that in the sink at any stage—a highly improbable state of affairs.

Bagnara gives the full tabulation of a particular case, stating that the ratio of homothety becomes a constant at 0.525, corresponding to 48 mesh, which indicates that at this mesh all the mineral is free; but an independent recalculation shows that actually the ratios continue to increase in magnitude beyond 48 mesh and finality is not in sight up to the finest size that could be screened out. In fact, in the case given, the actual ratios indicate (on Bagnara's theory) more middling in the finest size than in the next larger—a state of affairs at variance with the illuminating article on chats in the *Journal-Press* of Aug. 25.

My conclusion is that Bagnara's method has no secure foundation in physics or in mathematics.

Maracaibo, Venezuela. R. T. HANCOCK.

[In a recent issue we described the circumstances attending the untimely death of the author of the article on which Mr. Hancock now comments. We hope that the criticism will lead to further discussion.—Editor.]

A Suggestion for Mechanical Mucking

THE EDITOR:

Sir—I have been following with interest the development of mucking machines for narrow drifts, as evidenced by articles and advertisements in your columns. With the advent of such machines in practice, it occurs to me that it would be a step toward safer and more economical drifting to confine the broken rock as nearly in place as possible. This would result in a minimum shifting of the mucking machine.

After the round is drilled and ready to be blasted, let there be set up across the drift a steeply inclined surface sloping in toward the lifter holes, and extending from the top of the drift to within 24 in. of the floor. It must be spaced back from the face a sufficient distance to accommodate the increased volume of the rock due to breaking. The 24-in. clearance would serve the double purpose of providing an exit for the shot firer, and an opening through which the mucking machine could reach in and empty the improvised hopper of its broken rock. Doubtless, high cut holes would be necessary to minimize the possibility of displacing the apparatus with the blast.

The above-mentioned surface could be formed of old bars, rails, or slats positioned in spaced relation in a frame, so that the gases of the blast could readily escape between them. The whole structure would have to have the strength of a grizzly in order to withstand the impact of the breaking rock. It would also be advisable to design the frame so that the bars could be placed or removed from the outside, even when the hopper is full of broken rock, to facilitate the mucking process and avoid choke-ups.

Advantages of the device obviously are to concentrate the muck pile for convenient loading, and to protect straying laborers from flying rock fragments.

Woodland, Calif. J. E. RYPINSKI.

The Meaning of Depletion

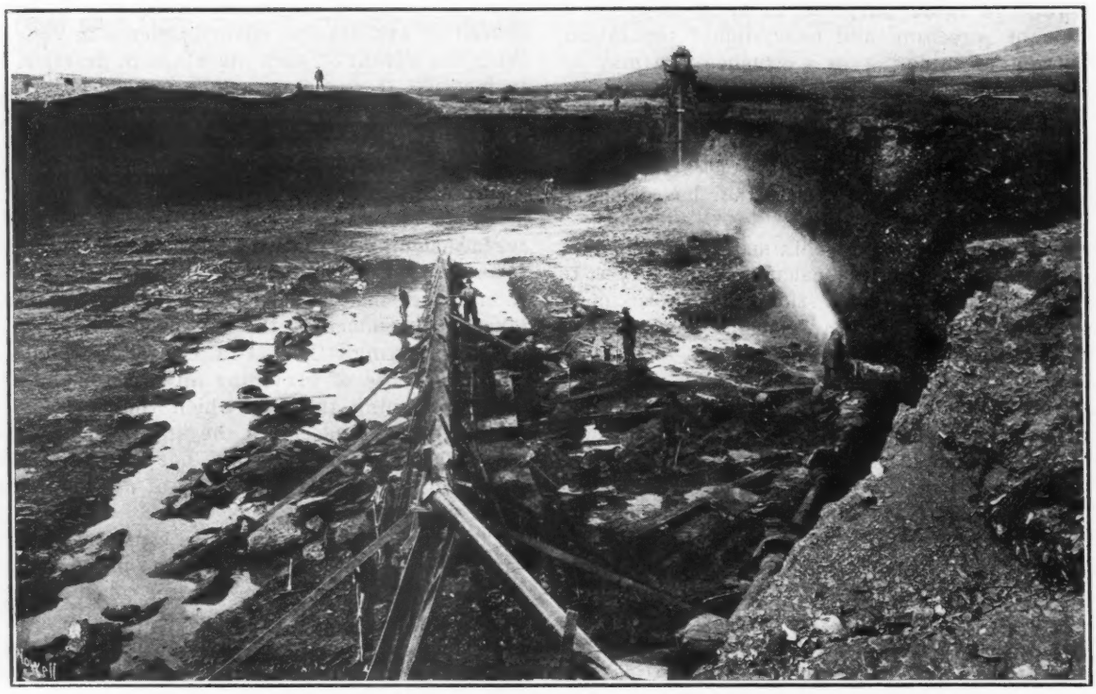
THE EDITOR:

Sir—Mr. Brinsmade's letter on "Bandit Taxation and Depletion" implies that the lawyer Congressmen, in their astonishing ignorance, have discriminated in favor of mine owners by permitting them depletion allowances. The phenomenon of various rich mines which are showing little or no income subject to federal tax, while at the same time they are yielding millions in dividends to their shareholders, is no more ludicrous than the spectacle we have when any taxpayer deducts the cost of his land from the selling price to arrive at his taxable income. In lieu of cost every taxpayer, mine owner or not, who owned land prior to March 1, 1913, is permitted to deduct the fair market value of his land at that date in computing his taxable gain. If we did not permit the mine owner to deduct the cost of his product or value as of March 1, 1913, if he owned it prior thereto, and at the same time did permit the land owner this deduction, we would discriminate against the mine owner.

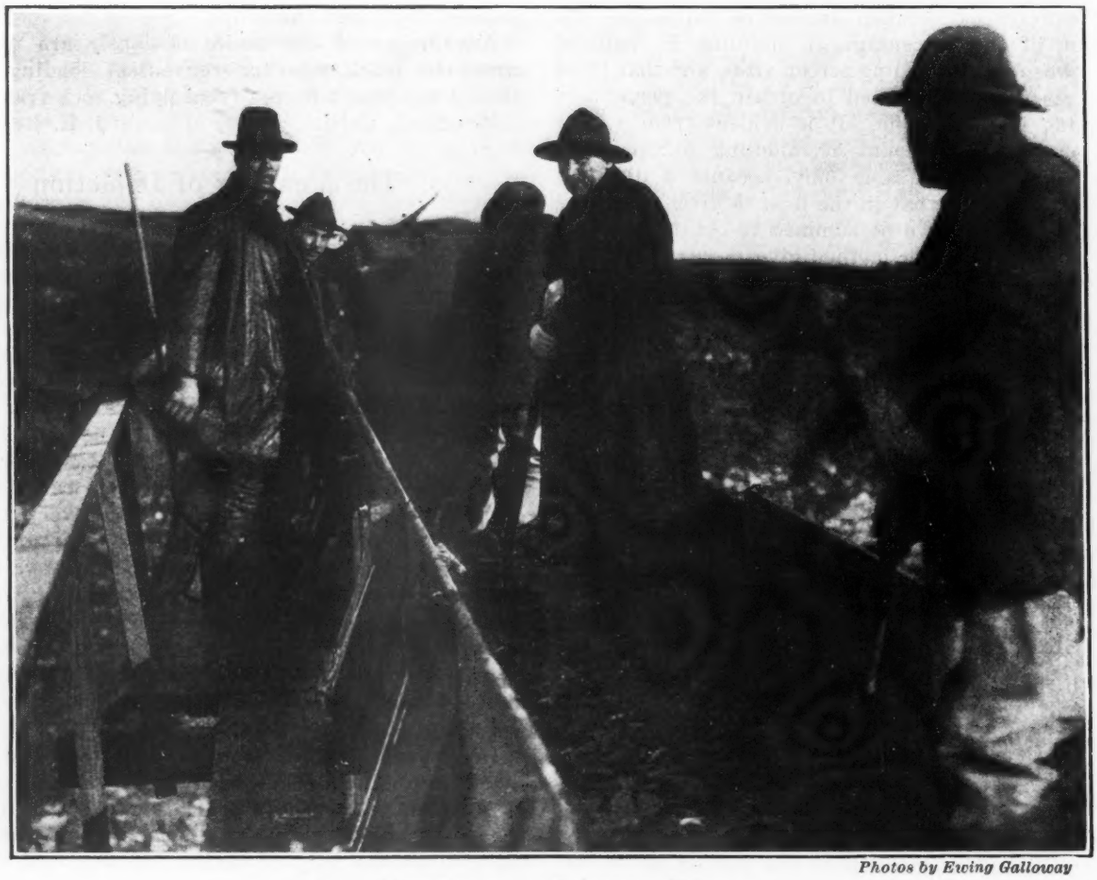
Depletion is nothing more nor less than the original cost of the mine owner's product, or value as of March 1, 1913, if he owned it prior thereto. The depletion allowance must stick until that happy time comes when we will see the folly of taxing industry and shift the tax burden to land speculators. Then we will have no income tax. S. L. GILLAN.

Los Angeles, Calif.

Placer Mining at Nome, Alaska



Hydraulic operations for gold, Glacier Creek, in the Nome region



Photos by Ewing Galloway

Shoveling out a sluice near Nome

Societies, Addresses and Reports

World Distribution of Graphite Discussed in Society Bulletin

GRAPHITE resources of the world, particularly of the United States, are discussed in a bulletin of the Mining and Metallurgical Society of America, recently issued, which contains the report of the subcommittee on graphite of the Committee on Foreign and Domestic Mining Policy. The committee consists of Edson S. Bastin, Henry A. Wentworth, and Benjamin L. Miller. Concerning the distribution of graphite, the committee observes:

"The crystalline graphite of international importance is produced in Ceylon, Madagascar, Germany, the United States, and Canada. The amorphous graphite comes from Czechoslovakia (Bohemia principally, but some from Moravia), Austria, Chosen (Korea), Italy, the United States, and Mexico.

"Chosen and Austria have also furnished considerable crystalline flake graphite, especially during the war. French Indo-China and Spain in recent years have contributed considerable amorphous graphite, but it is as yet doubtful whether they will continue to be important factors in the world situation. At any time a new and important district may come into the field and quickly surpass other long established regions. Madagascar furnishes an illustration of this statement. Until 1911 it had only an insignificant production, but the industry expanded so rapidly that in 1917 it occupied second place among the graphite-producing countries of the world, only exceeded by Germany, where the demands of the war necessitated an unprecedented production. Madagascar will undoubtedly long continue to maintain its position as one of the dominating graphite producing countries of the world."

The committee concludes that the Ceylon reserves of graphite are probably large, that Madagascar can maintain its annual production of 40,000 tons of graphite of 90 per cent carbon content for many generations; and that other countries have large reserves. The flake graphite deposits of the United States, located in New York, Pennsylvania, Alabama, and Texas, "could easily supply the needs of the graphite manufacturers of this country for probably hundreds of years," although "there is not much hope of the graphite producers ever being able to compete successfully in the leading foreign markets of the world." The report continues: "There is no question that the United States could become independent with respect to graphite, but not without disastrous results. For example, the United States exports lead pencils in large quantities to practically all the countries of the world in competition with old well-established European pencil makers. This can only be done by the use of amorphous graphite imported from Mexico."

Altogether, it is clear that graphite is not one of the commercially valuable minerals the supply of which is likely to be exhausted in the near future, but belongs to the group of which there is plenty to be had, at a reasonable effort.

Statistical Association Will Meet in Washington

On Dec. 27 to 29 inclusive the American Statistical Association will hold its eighty-fifth meeting at Washington, D. C. The sessions have been divided into such broad topics as the business outlook, trade, manufacturing, mining, agriculture, transportation and building, banking, credit, and investment. The general topic for all sessions will be the statistical basis for analyzing the current economic situation, with the object of making forecasts of business conditions in general.

John Hays Hammond is scheduled to preside at the mining session at 2 p.m. on Dec. 28, at the New Willard Hotel. The titles of the papers to be presented are: "Fluctuations in Mineral Output," by George Otis Smith and others; "The Effect of New Technique on the Past and Future Production of Petroleum," by Joseph E. Pogue; "Trade Statistics and the Non-Ferrous Metals," by E. H. Robie and F. E. Wormser; and "The Bituminous Coal Industry in Prosperity and Depression," by D. L. Wing and F. G. Tryon.

New York Section A.I.M.E. Hears About Congo Copper

"Copper operations in the Congo" was the subject of an unusually informing talk by Archer E. Wheeler, at the regular monthly meeting of the New York Section of the A.I.M.E. held at the Harvard Club on Dec. 5. Mr. Wheeler, who is consulting engineer for the Union Minière du Haut Katanga, had more than 100 lantern slides showing various features of the journey from Capetown to the copper region as well as of the mining operations themselves. The Bwana M'Kubwa Company, in which Minerals Separation has recently acquired an interest, may develop into a big property, but the only actual producer in the Congo is the Union Minière. The company is now producing at the rate of about 150,000,000 lb. of copper per year from ore averaging about 7 per cent. Transportation of supplies into the country and of copper to the coast is one of the heaviest items in the cost of production. Mr. Wheeler spent a year and a half at the concession, and his account was supplemented by pictures.

Oil Men Meet at Statler in St. Louis

Standardization of Equipment Has Important Place on Petroleum Institute's Program

The fourth annual meeting of the American Petroleum Institute was held in the Statler Hotel, St. Louis, Dec. 11 to 13. Much of the time was devoted to group sessions on various topics. At one of these the subject of "Standardization, Simplification and Improvement of Oil Drilling Methods and Equipment" was considered and various papers were read. Among these were "The Study of Oil Field Working Conditions by the Bureau of Mines," by F. B. Foley; "Standardization of Rotary Tool Joints," a committee report by S. A. Guiberson, Jr., chairman; and "Standardization of Belting," another committee report by R. D. Gwynne, of the Gypsy Oil Co.

At other group sessions papers on standardization of cable tools, rig irons, derricks, ropes and rotary drilling equipment were presented.

Mining Conditions Looked Into at Sacramento

On behalf of the Senate Committee on Gold and Silver Inquiry, Fletcher Hamilton held a conference with mining men at Sacramento, Calif., Dec. 3 and 4, 1923. A number of mining men offered testimony on their special difficulties and on the mining situation in general. It was shown that, compared with 1913, wages in the gold mines of California had increased 65 per cent on an average, the extremes of increase ranging from 40 to 90 per cent, and in copper mines 63 per cent, the extremes ranging from 38 to 80 per cent. Supplies and powder have also increased greatly, the former showing a range from 9 to 86 per cent and the latter 41 per cent. A greater labor turnover and also a marked decrease in efficiency contributes to the cost of operation. One operator stated that compensation insurance added from 35 to 40c. per day to the expense for each worker and suggested that compensation insurance be divided equally between employer and employee.

Director Reports on Work Done by Geological Survey

According to the annual report of the Director of the U. S. Geological Survey for the fiscal year 1923, the work of the Survey has covered effectively the broad field assigned to it, embracing geologic and topographic surveys, the study of mineral deposits, the collection of statistics of mineral production, the measurement of the flow of streams to determine the quantities of water available for use and to provide information needed for projects designed to prevent floods, the study of available ground water, and the classification of the public lands preliminary to the issue of patents or leases.

Recent Technical Publications

Reviews, Abstracts, and References

Building Stone and Cement

The Building Stones of Kentucky. By C. H. Richardson. Kentucky Geological Survey, Frankfort, Ky.

This is a welcome addition to state reports on building stone. The preliminary section devoted to mineral constituents, physical properties, and weathering of building stones occupies about twenty-five pages, and is followed by a comprehensive discussion of sedimentation. The deposits and quarries are described in some detail. The available rocks consist of limestones, sandstones, and marbles, no granites occurring within the state. A 66-page section of chemical analyses is followed by production statistics, and a bibliography of building stone literature. There is some confusion of subject headings, particularly under "The weathering of building stones," and possibly the short chapter on description of microscopic slides in the early part of the book would fit in more logically with the later chapter on chemical analyses. The subject is covered in a thorough manner, and adequately supplies general information on the building stone resources of the state.

OLIVER BOWLES.

Cements and Artificial Stone. By the late John Watson. Published by W. Heffer & Sons, Ltd., Cambridge, England.

This book of 131 pages begins with the history of portland cement manufacture in England. Specimens in the Sedgwick Museum, Cambridge, of raw materials used in British portland cement manufacture are described in some detail with analyses. Processes of manufacture are given in brief, together with descriptions of various cement products such as fibro-cement, stucco, concrete, reinforced concrete, and artificial stone. Brief descriptions are given of several more or less related products represented by museum specimens, among them Roman cement, gypsum, plaster of paris, and Keene's cement. A bibliography of portland cement manufacture is added.

OLIVER BOWLES.

Annual Report of the Director of the Mint. For the fiscal year ended June 30, 1923. Document No. 2,928. U. S. Treasury Department, Washington, D. C. Obtainable upon request.

As usual, the informative report of the Director of the Mint contains an exhaustive review of the production and consumption of gold and silver in the United States during the preceding calendar year, and a summary of data regarding gold and silver production, consumption, and monetary conditions in foreign countries. Government purchases of gold during the year under review totaled $336,000,000, a figure approximately double that for the years immediately preceding the World War, but a material reduction from the amount received in 1921 and 1922 when $673,000,000 and $540,000,000, respectively, was absorbed. The government also bought 70,000,000 oz. of silver, all but about 2,000,000 oz. of which was Pittman Act silver, purchased at $1 per oz. Coinage mints were operated throughout the year at Philadelphia, San Francisco, and Denver; an assay office at New York, which sells large amounts of gold; mints at New Orleans and Carson City conducted as assay offices; and assay offices at Boise, Helena, Deadwood, Seattle, and Salt Lake City. Electrolytic refineries were operated at New York and San Francisco. Technical improvements included the installation of a ventilating system and a Cottrell precipitation plant at the New York plant, which is briefly described, and the substitution of fuel gas for oil at the Denver mint, resulting in a marked decrease in copper oxidation and a net saving of about 30 per cent of the former cost of annealing.

Graphical Analysis of Stresses Involved in Designing Frame Structures. By G. P. Schubert, assistant professor of civil and mining engineering, Michigan College of Mines, Houghton, Mich. Published by the author.

The material published in this book covers a course of study given to engineering students at the Michigan College of Mines, in the theoretic value of the stresses that exist under different conditions in the members of various frame structures. It was written for the purpose of presenting some of the fundamental principles involved in the design of mine structures.

Ferromanganese — The November issue of *The Anode*, published by the Anaconda Copper Mining Co., Butte, Mont., for free distribution, contains a five-page article describing the equipment and operation of the electric-furnace plant at Great Falls for the manufacture of ferromanganese from rhodochrosite, mined at Butte. The furnaces operate with approximately 4,000 kw. input and 75 to 80 per cent power factor. Each furnace, of which there are five, will produce from twelve to fifteen tons of alloy per twenty-four hours, from fifty-five to seventy-five tons of charge.

Mine Timber—The application of standard formulas in the proper design of mine timbers is discussed briefly in a 6-page paper in the *Proceedings* of the Australasian Institute of Mining and Metallurgy, No. 49, March, 1923. (Melbourne).

Iron Smelting — U. S. Bureau of Mines *Reports of Investigations* No. 2.524 (obtainable on request from the Bureau at Washington, D. C.), six pages, describes progress in iron blast furnace research.

Canadian Asbestos—*Compressed Air Magazine* is running a series of articles on "Canada's Great Asbestos Industry" (11 Broadway, New York City; price 35c. each issue). Part I, in the November issue, told something about the geological origin and the general nature of asbestos, and described the methods of mining and handling it before milling. Part II, in the December issue, discusses milling and grading the material for market.

Patents

Electrolytic Cathode—No. 1,468,838. Sept. 25, 1923. C. H. Schuh, Brooklyn, N. Y. A cathode comprising a plate of a "film-forming metal," with a chamfered edge, adapted to fit a non-conducting frame.

Classifier—No. 1,468,844. Sept. 25, 1923. R. S. Trott, Denver, Colo. A drag classifier of the Dorr type, the novelty consisting principally in the design of the rake actuating mechanism.

Amalgamator and Separator—Nos. 1,469,007 and 1,469,008. Sept. 25, 1923. Charles Meyer and H. B. Meade, Los Angeles, assignors to F. A. Gillespie, Los Angeles. These two patents cover devices for amalgamating ores and for removing the amalgams thereby produced.

Selective Flotation—No. 1,469,042. Sept. 25, 1923. G. A. Hellstrand, Butte, Mont. An ore pulp containing zinc sulphide and other metallic sulphides is treated with not over 7 lb. of a soluble sulphide per ton of ore, so as to inhibit the flotation of zinc sulphide, and then subjected to the flotation process for the recovery of the other metallic sulphides.

Sintering Machines—No. 1,469,520. Oct. 2, 1923. R. L. Lloyd, New York City, assignor to Dwight & Lloyd Sintering Co., New York City. The patent covers automatically movable cleaners adapted to enter the apertures of the grates of D. & L. machines after the ore is discharged.

No. 1,469,521 covers a guide for the grates as they move in each direction, and a power transmitting device for moving them along the lower guide, actuated by the moving grates above.

Pan Concentrator — No. 1,470,011. Oct. 9, 1923. F. E. Johnesse, Boise, Idaho. A pan concentrator with an oscillating motion, means for making the ore stratify, and a concentrate discharge projecting radially outward and upward, and arranged to permit the escape of concentrate under centrifugal force from the lower and outer zone of the pan.

Ball-Mill Lining—No. 1,470,420. Oct. 9, 1923. T. B. H. Askin, Denver, and G. H. Ruggles, Inspiration, Ariz., assignors to F. E. Marcy, Los Angeles. The patent covers a method of using pillow blocks under step liners in ball mills, the idea being to save scrapping the steel contained in liner plates which otherwise must be made needlessly thick. The idea has been successfully applied at the Inspiration mill.

MEN YOU SHOULD KNOW ABOUT

Carl O. Lindberg, of Los Angeles, Calif., has returned from the Orient.

Frank E. Shepard has been appointed Superintendent of the Mint at Denver.

Dr. Kuno B. Heberlein has returned from four months' business trip in Europe.

Cyrus F. Weeks, consulting engineer of Tucson, Ariz., was recently in San Francisco.

F. M. Manson, manager of the Western Ore Purchasing Co., has returned to Reno after an extended business trip.

Robert J. Grant, Director of the Mint, was in San Francisco late in November en route to Washington, D. C.

P. L. James, of the Canadian Geological Survey, has been examining properties in the Rouyn gold area of Quebec.

Dr. Sydney H. Ball has returned to New York from a two months' professional trip to Europe, principally Portugal.

Frederick G. Clapp sailed on Dec. 4 from San Francisco for an absence of several months on professional investigations in Australia.

Percy E. Hopkins will resign his position in connection with the Ontario Department of Mines to enter the service of the Mond Nickel Co.

Louis Buchman on Dec. 1 accepted an appointment as assistant superintendent of mines for the Utah Copper Co., at Bingham Canyon, Utah.

A. F. Carper, mining engineer with the Tonopah Mining Co. for many years, has removed to Denver to take charge of important mining property in that vicinity.

John W. Bergin, who superintends hydraulic operations for the Round Mountain Mining Co., at Round Mountain, Nev., has returned to the mine from San Francisco.

L. D. Gordon, president and general manager of the Round Mountain Mining Co., has returned to Round Mountain after being delayed in San Francisco for several months with an injured knee.

David White represented the U. S. Geological Survey at a meeting held Dec. 6 by the Academy of Natural Sciences of Philadelphia in commemoration of the centenary of the birth of Joseph Leidy.

D. C. Bardwell, a physical chemist on the staff of the Bureau of Mines, is being transferred from the Reno experiment station to the Bureau's Washington office. He will continue his research work on rare metals.

C. S. Robinson, of Youngstown, Ohio, vice-president of the Youngstown Sheet & Tube Co., recently completed an inspection of the Newport and other newly acquired mines of the company in the Lake Superior region.

Arthur Notman, former mine superintendent of the Copper Queen mine, at Bisbee, and **J. R. Finlay,** of New York, are stopping for a few days in Bisbee upon their return to the States after having examined mining property near Nacozari, Mexico.

T. C. Earl has been appointed consulting dredging engineer of the Dome Mining Corporation, which owns a gold mining proposition in Spain. The company has been in need of funds, and it is officially stated that a financial group has now provided them.

James Anderson, Mayor of Kaslo, B. C., is acting as the representative of British interests that are expected to reopen the Jackson Mines, which include a group of six properties. Recent developments have resulted in good showings.

James Anderson

Reed Bush has been appointed State Oil and Gas Supervisor of the California State Mining Bureau. Mr. Bush was formerly with the Department of Oil and Gas of the Bureau and was subsequently with the Pacific Oil Co. and the Empire Oil Co. of Kansas.

Fletcher Hamilton, for ten years state minerologist for California, has represented the United States Sonate Commission of Gold and Silver Inquiry at hearings in Nevada as follows: Virginia City, Dec. 5 and 6; Tonopah, Dec. 7 and 8; and Las Vegas, Dec. 11.

John M. Iles, who is regarded as well-informed on tin mining in Nigeria, is joining the board of the Sha Falls. It is said he was asked to take the chairmanship, but declined. John Waddington, who was a successful participant in the Westralian boom, is also a director.

A. E. Lowe, who has been superintendent of the Tonopah North Star mine, in Tonopah, for the last ten years, has moved to California, where he will have charge of operations of the North Star and Umatilla companies on newly acquired properties.

G. R. Mansfield has been appointed to represent the U. S. Geological Survey at the annual meeting of the American Association for the Advancement of Science to be held at Cincinnati Dec. 27 to Jan. 2, the seventy-fifth anniversary of the founding of the association.

Amos Beaty, of New York, president of the Texas Company, was in Houston recently on his customary trip of inspection of the Texas Company's properties. While in Houston he was joined by **R. C. Holmes,** vice-president in charge of refining, and **Judge C. D. Ames,** general counsel, both of New York.

Robert McCart, Jr., who has been directing development operations for the past six months at the Comstock Merger Mines, Inc., and the Nevada Canyon Mining Corporation properties, at Virginia City, Nev., has completed his engagement, and after a short stay on the Pacific Coast will return to headquarters at El Paso, Tex.

T. H. Jenks, of Los Angeles, since leaving Denver and Cripple Creek, Colorado, early in October, has been engaged continuously in professional work in Sinaloa, Chihuahua, and Durango, Mexico. He has returned from the Guadalupe y Calvo district, in Chihuahua, to Sinaloa, and expects to return to Los Angeles by the end of the year.

H. W. Edmondson, 326 Chapman Building, Los Angeles, has returned from an extended trip to New York, Boston, and Vermont in connection with the holdings of the Asbestos Corporation of America. This company's property is equipped to become an important producer of asbestos in the United States, and has large reserves of asbestos rock. It is expected to begin production in the near future.

John A. Swanson has recently been appointed mine superintendent for the Hidden Creek mine of the Granby Consolidated Mining, Smelting & Power Co., Ltd., at Anyox. Mr. Swanson is a well known mining man, especially throughout the northwest. He has been with the Granby company for the last twenty-five years and during most of that time has been in charge of the underground work at both Phoenix and Anyox, where he has successfully developed the mining of low-grade orebodies under the system of glory holes and open stopes. **W. J. Coulter** has been appointed his assistant.

H. C. George, petroleum engineer of the U. S. Bureau of Mines, has assumed the post of supervisor of oil and gas producing operations in the Kiowa, Apache, and Comanche reservations. This assignment, together with his detail to certain areas under the Five Civilized Tribes, places Mr. George in charge of oil and gas operations on all Indian lands in southern Oklahoma. Mr. George and **John R. Bunn,** assistant petroleum engineer, are now making an engineering study of the Fox and Graham oil fields of Garter County, Okla., for the U. S. Bureau of Mines, preparatory to the publication of a report and maps of these oil fields.

THE MINING NEWS

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Summary of the Week

ESTIMATES from statistics published in the trade show withdrawals of copper from refineries for both foreign and domestic account to total 224,000,000 lb. This establishes a new record, exceeding March of this year.

Minnesota mineral land valuations are increased by $15,397,341 over those of last year.

Dividends from Ontario gold and silver mines for 1923 will total $8,740,000.

The Union Minière is now producing copper at the rate of 12,500,000 lb. per year from its Katanga mines, in Africa.

Modification of its pension system by the Phelps Dodge Corporation is announced at Bisbee, Ariz.

Cripple Creek development in lowest levels is encouraging to operators in Colorado.

Inquiry on the application to reduce the magnesite tariff elicits contradictory views.

The Secretary of the Interior explains the reasons for suspending payment of War Minerals claims pending conclusion of mandamus proceedings.

The Federal M. & S. Co. plans to prospect outlying ground in Picher, Okla., zinc fields.

Further news from Queensland, Australia, indicates that reports of newly opened lead deposits are not exaggerated.

The Verde Central Copper Co. will sink a new three-compartment shaft at Jerome, Ariz.

Phelps Dodge Modifies Employees' Pension System at Bisbee

Retired Workers Get Annuity of 2 per Cent for Each Year of Service—Ninety-four Now on List

The Copper Queen Branch of the Phelps Dodge Corporation, at Bisbee, Ariz., has announced a revised pension plan for its employees. This company is one of the few mining companies, if not the only one, in the Southwest that provides pensions for its men, and the plan now in effect is a liberal one both as regards time of service required and amount allowed. After fifteen years' service any employee permanently incapacitated may retire with a pension, or the company may, at its option, retire any worker on pension. An employee that has reached the age of fifty-eight years or more at the time of approval of his application for pension will receive an annual sum equal to 2 per cent of his average earnings multiplied by the years of service. Any employee that is pensioned before that age will receive a pension based in the same manner, but reduced in an amount proportionate to the expectancy of life at his age as compared to that at the age of fifty-eight. Under the former plan, the pension was based on an average of earnings for three years immediately preceding his retirement. The report of the company's committee of last year showed that during the year 1922 twenty-one additional pensions were granted to retired employees, making the total men on pension ninety-four. The corporation also maintains an employees' benefit association which operates a blanket insurance for its men. These measures have been effectual in increasing the stability and efficiency of the working force and keeping the men contented.

American Beauty, in Nevada, Has Excellent Lead Showing

The American Smelting & Refining Co., which recently took a six months' option on a controlling stock interest in the American Beauty mine, 34 miles southeast of Elko, Nev., has financed the construction of a branch road from the main road to the mine, and ore shipments are to be started to the smelter at once.

The vein has been exposed by surface and underground work for 4,000 ft., and it is claimed that there is good ore available at many points, both in surface and underground workings. The best galena ore will run over 50 per cent lead, and contains a few ounces silver to the ton. The lower-grade ore will have to be sorted or concentrated to a shipping grade. It is hoped to be able to work continuously through the winter months, although weather conditions will undoubtedly make it impossible to reach the mine at times with trucks, and sleds will have to be resorted to over the worst part of the road to the truck station. The property is controlled by the J. & J. Smelting & Development Co. with headquarters at Eureka.

New Milling Operations in Joplin-Miami Zinc Field

Skelton and Barnsdall Increase Output —Tailing Conveyors Installed in Two Plants

The Skelton L. & Z. Co. has completed its field shaft on its No. 8 lease, at Century, Okla., and is building a derrick and hopper, after which the mill will be placed in production. The company also recently has installed a belt tailing conveyor at its No. 4 mill and probably will put one in at its No. 7 mill in the near future. A new field shaft also is being put down at its No. 7 property, which will be completed by the close of December. The company has been producing about 500 tons of zinc ore per week, despite the fact that recently only two of its mills have been operating. Frank Childress, of Joplin, is general manager for the Skelton company.

The Barnsdall Zinc Co. has resumed operations at its No. 3 mill in the Waco, Mo., field. The mill is on the Kansas side of the line and has been idle for two months. Most of the ore will be taken from the upper run, but some dirt will be taken from the 312 level, where drilling has shown good deposits.

The company has been operating its No. 2 property, on the Missouri side, steadily all year, but its No. 1 mill will continue idle for the present. It is planned to close down both the No. 2 and No. 3 mills the Saturday before Christmas for the holiday period.

Cripple Creek Companies Find Good Showing in Deep Work

Sinking Reveals High-Grade — Water Problem Serious—Pump Stations at Wide Intervals

Plans for deep mining in the Cripple Creek district, in Colorado, are well under way, and reports from operations on the lower levels of the Cresson and Portland, where new levels are being opened, are encouraging.

Advance drill holes at the head of the drift which is being run on the 27th level of the Portland to open up the oreshoot on the new level indicate the approach to the ore. Drillings from the holes assayed 100 oz. in gold and 65 oz. in silver. While awaiting the arrival of its pumps from the factory the company has advanced the crosscut which it was intended to drive within a few feet of the vein, when the work would be suspended until the pumps were ready to handle the flow expected when the vein was cut.

The company expects to have its pumps in operation about Dec. 10, and the vein will at once be opened up. Sinking will then be resumed; a station will be cut at 135 ft., but no development will be done at this point until the shaft is down 270 ft., or to the 29th level. Another set of pumps will be installed here.

Reports are that the Cresson company, providing the ore on the 18th level is as good as expected, will sink the shaft an additional 700 ft. The winze which is being sunk from the 17th to connect with the new level is down 165 ft., and indicates values even better than the level above. By sinking 700 ft., the Cresson will save the cost and time of installing pumps at each level, and will make the main pumping station on the bottom level, or at an elevation about 825 ft. below the drainage tunnel.

Minnesota Adds $15,397,341 To Valuation of Mineral Lands

The assessed valuation of mineral lands in the State of Minnesota has increased more than $10,000,000 in the last year, according to a statement issued by the Minnesota tax commission. The assessment for 1923, including unmined ore and stockpiles, amounts to $287,071,774, which shows a large increase in comparison to $276,787,154 for 1922, despite the shipments of approximately 30,000,000 tons of ore last season. The increase was due to the addition of 5,519,746 tons of ore, valued at $30,794,682 and having a taxable value of $15,397,341. This added tonnage to the taxable list is due in part to new explorations and revised estimates and in part to the new policy adopted by the commission in determining tonnages. Under this policy the estimated orebody is extended an appreciable distance beyond the outside drill holes, when such holes show a substantial quantities of ore having a reasonably high iron content.

Rich Ore Pays Even on Mediocre Market

THE Vantage Mining Co. has recently opened up an unusually rich lead cave at its No. 1 property, at Picher, Okla. By experienced mining men who have visited it, it is declared to be the richest mineralized cave of all the many that have been discovered in this field in recent years. The Vantage company has been a steady producer for a number of years, and testimony in a recent court action was to the effect that already it has paid 440 per cent in dividends on a capitalization of $150,000.

Tonopah Divide Mines a Little and Prospects Much

The Tonopah Divide Mining Co. is not attempting to crowd production at its Divide, Nev., mine. It is producing sufficient ore to take care of operating expense, and is doing some important development work. Production at present is around 300 tons of ore per month. Most of the work being done is on the 1,300 level, where a southeast drift is being driven along the hanging wall of the vein, with footwall crosscuts at intervals of 75 ft. So far the vein material is not pay ore, although it carries encouraging and consistent values. It is reported that this southeast drift is approaching the projected position of the most important oreshoot developed on upper levels, from which the main production of the mine has come. Other development work is being done on the first, second, and third levels, with nothing new to report. The company is also planning some work near the surface on the old gold vein, which was the original producer of the mine, and which was the objective of the first crosscut on the first level from the vertical shaft when the silver vein was discovered. Crosscutting at depth failed to locate the vein, and it is thought possible that it may have flattened to the south.

Silver-Lead Shoots in Jack Paul Mine Open Well

The Jack Paul Mining Co., operating near Midway, B. C., is developing excellent ore. The property contains five veins, all of which carry from 15 to 25 oz. silver, $2 to $3 in gold, and 5 to 25 per cent lead. The veins are from 2½ to 8 ft. wide.

No. 1 tunnel reached the vein at 75 ft. of depth, and drifting for 240 ft. has developed the vein, which averages $25 per ton. Assays as high as 104 oz. silver and 24 per cent lead have been obtained. No. 5 tunnel has developed ore 8 ft. wide; it has been drifted on for 80 ft. and contains $12 to $15 per ton. The plans of the company are to open sufficient tonnage to warrant a mill, according to Frederick Keffer, manager.

Ontario Mines Will Pay $8,740,000 Dividends for 1923

This Excludes Nickel Producers—Gold Producers Lead—$131,983,000 Paid in Twenty Years

Shareholders of the precious metal mines of northern Ontario have little cause for complaint during the present year, as the dividends paid and to be paid in 1923 are the largest for a number of years. The total dividends of the mining companies this year will amount to $8,740,000, compared with $7,806,000 in 1922 and $5,982,000 in 1921. Of this year's total $2,050,000 is contributed by the silver mines, and though this is a substantial amount it is small in comparison with 1912, when Cobalt mines alone paid over $9,300,000, or more than the total of all gold and silver mines this year.

The largest proportion for 1923 is from the Porcupine mines, with $6,255,000; two gold mines in Kirkland paid $435,000. The total paid to the end of 1923 by Ontario's gold and silver mines amounts to $131,983,000, which is a remarkable achievement in view of the fact that the first discovery was made just twenty years ago. Of this total, the silver mines contributed over $94,000,000, Kirkland mines $1,290,000, and Porcupine mines $27,938,000. With the rapid expansion of the gold-mining industry, dividends from this source may be expected to show a material increase in the near future.

Kerr Lake Will Conserve Cash for Development Purposes

Directors of the Kerr Lake Mines Co., of Ontario, have not declared the quarterly dividend of 12½c. a share, which in the ordinary course of events would be payable Jan. 15. They announce that on account of the increased developments which the company has under way it has been considered advisable to conserve the cash resources by the payment of semi-annual instead of quarterly dividends. During the last few years a considerable part of the company's revenue was derived from the Vipont silver mine, in Utah, but when the U. S. Government stopped the purchase of silver, under the Pittman Act, this revenue was largely cut off. To date the Kerr Lake mines has distributed $9,685,000 in dividends to shareholders.

Herb Lake Gold Finds Important

The strike recently reported at Herb Lake, Manitoba, by a prospector named Rivoid is apparently of considerably greater importance than was at first supposed. A well-defined quartz vein carrying much gold and varying from 3 to 10 ft. in width has been traced through seven claims. Panning has been done in many places, showing free gold. Claims at Herb Lake are changing hands freely. The Rex mine is being sampled by engineers representing the Mining Corporation of Canada.

Steam-shovel working the Star of the Congo mine of the Union Minière

Union Minière Plans to Increase Current Monthly Copper Output of 12,500,000 Lb.

Archer E. Wheeler Describes Katanga Operations—Metal in Reserves Equals Utah Copper's, but Ore Is Richer—Leaching Will Be Introduced—Transportation Big Problem

By **Arthur B. Parsons**
Assistant Editor

SOME PEOPLE have a notion that the operations of the Union Minière du Haut Katanga, in the heart of Africa, loom as a sort of copper menace. As with the "Yellow Peril," the remoteness of the place and the lack of definite knowledge regarding conditions are responsible in a measure for this idea. The latest estimates of proved ore reserves show 68,000,000 metric tons of ore averaging 6.62 per cent copper, nothing assaying less than 3 per cent and only oxidized ore being considered. This is equivalent to 9.9 billion pounds of metallic copper, which is only about 200 million more than is calculated in the reserves of the Utah Copper Co. at its great porphyry mine at Bingham, Utah, where the ore averages only 1.35 per cent copper, however. At Chuquicamata, the Chile Copper Co. has proved oxidized ore assaying 1.91 per cent copper that contains about 15.5 billion pounds, in addition to mixed and sulphide ores that bring the total to about 29 billion. The Tanganyika Concession, in which the Union Minière has the exclusive copper rights, has an area of 8,100 square miles, and future prospecting will doubtless disclose many large and valuable deposits. After the obituary of the Star of the Congo, the oldest mine, had been written several times, 5,000,000 tons of ore averaging 10 per cent copper was found by drilling. It seems safe to say that the company owns the largest developed deposits of high grade copper ore known today.

According to Archer E. Wheeler, the American metallurgist, who is consulting engineer for the Union Minière, the current output is about 12,500,000 lb. per month. This compares with 19,500,000 for Utah and about 19,000,000 for Chile. The limiting factor at present is the capacity of the blast-furnace plant. Expansion in the near future will probably be in the direction of increasing the furnace capacity, but ultimately the treatment will be by leaching with sulphuric acid, if present plans are carried out. Mr. Wheeler, who designed the contemplated plant in his New York office, has demonstrated conclusively that leaching is the most profitable treatment for ore of any grade even up to pure malachite. In 1916, Mr. Wheeler went to the Congo to study methods of treating the ore that had been placed on the dumps as too low grade for treatment. It assayed only 15 per cent copper! He recommended leaching, the program was approved by the directors, and the plans were drawn. However, circumstances arising out of the war changed the decision and it was decided instead to erect a concentrator. This plant, finished in 1921, contains Hartz jigs, Hancock jigs, and Wilfley tables. No attempt is made to recover copper from the slime, though some of it is impounded. This plant will handle 4,000 to 4,500 metric tons per day. Heads range from 7 to 10 per cent copper and tailing from 4½ to 5 per cent. The extraction varies between 45 and 60 per cent of the contained copper.

The work of the white ant; the "hill" is 10 ft. high

The smelter consists of seven ordinary blast furnaces, three of which measure 48x192 in., and the others 44x240 in. Black copper is made with a negligible amount of matte, coming from the sulphur in the coke. Fluxes are limestone of good grade and ironstone that is not so good; both are obtained locally. An attempt was made to briquet the concentrate at first, but this has been discontinued.

The Congo country lives up to tradition. This photograph was taken on the Concession

Trees which cover the country are good for fuel but not for timber

A native leader and his family, including three children

The furnace feed is high-grade ore mixed with jig and table concentrate to average about 24 per cent copper. The slag is not clean, as might be imagined with such a charge.

The coke comes in part from the Wenke Colliery Co., operating in Rhodesia, and in part from the company's own retort coke ovens near the smelter. These it seems were built primarily to call a bluff on the part of the coal company. However, the gas is used to heat the steam boilers. Recently a reverberatory furnace has been installed. In it reducing smelting is accomplished to produce metallic copper as in the blast furnace.

No one realizes better than the management that the metallurgy is not efficient. With the erection of the leaching plant an excellent recovery will be possible. About 98 per cent of the copper can be dissolved, and the recovery will depend upon how completely it will pay to wash the tailing. The pig copper is shipped for refining to Europe or the United States, the Nichols Copper Co. being the recipient of more than half the current output. The gold and silver content of the ore is practically negligible, but the pigs contain some sulphur, iron, and cobalt. Production started in 1911, when 1,000 metric tons was produced. A gradual increase to 27,500 metric tons in 1917 was followed by a slight decline until 1922, when the output again increased, the output for that year being 42,400. The present rate is about 65 per cent higher than last year.

The concession is covered with the characteristic bush shown in the accompanying photograph. The orebodies in the early days were found on bare spots, generally on hills. It was thought at first that there was some connection between the absence of trees and the copper ore, but this has been disproved, as the deposits are often found beneath "bush." The ore occurs in stratified dolomitic beds lying at any angle from vertical to horizontal. The dolomite may be leached and replaced by malachite, which is the principal copper-bearing mineral. Some chrysocolla, less azurite, a little cuprite, and a few sulphides have been found. The latter are not considered as being a part of the ore reserve, but they may later be a source of sulphuric acid for leaching.

Prospecting is done largely by churn and diamond drilling; the holes are seldom more than 1,250 ft. deep, indicating comparatively shallow deposits. Drilling is usually done at points representing the corners of 100-m. squares, but this may be varied by either closer or wider spacing. To date virtually no underground mining has been done, and most of the open-cut work is done by steam shovels. The deposits are scattered and many surface plants are necessary.

The ore is divided into three classes: (1) direct smelting ore, richer than 15 per cent; (2) concentrating ore, which includes "low-grade" material which can be concentrated; and (3) leaching ore, which is described by Mr. Wheeler as a sort of chalky material impregnated with copper carbonate in which the copper mineral cannot be liberated by crushing. It should be emphasized, however, that all three classes of ore are readily amenable to leaching and that the greatest profit from any class of ore will come from this treatment.

A typical native worker in his digging clothes

The Tanganyika Concession is 250 miles long and varies from 10 to 50 miles wide. In addition to the exclusive copper rights the company has a half interest in any other mineral deposits found. Tin and radium ores have been exploited to some extent. The mines being operated at present and the concentrator at Panda are near the eastern end of the concession about 92 miles north of Elisabethville, which is the site of the smelter and the headquarters of the company. The property is in the extreme southeast corner of the Belgian Congo. Travelers usually enter by way of Cape Town, the rail journey of 2,308 miles northward taking them through the diamond mines at Kimberley and through Rhodesia.

Freight, including incoming supplies and outgoing copper, is routed through the port of Beira, on the east coast, thereby reducing the mileage by rail. The railroad is government owned, and, running through a country supplying little traffic, the rates are very high. This is one of the biggest elements (approximately one-half) in the cost of delivering copper to the refinery in Europe or United States. A 1,100-mile rail route from the Lobito Bay, on the west coast, is completed about half way to the concession. Railroad locomotives as well as boilers at the mines are fired with native wood, which, incidentally, is of little use as timber or lumber. The cost of transporting this fuel is high.

Elisabethville is a town of 2,500 white people and a large but uncertain population of negroes. The company employs in its operations about 1,000 whites and 12,000 "boys," recruited from both Rhodesia and the Congo. The government requires that strict measures be taken to care for the "boys," who live in compounds sometimes containing thousands. The cost for innoculation against disease and maintenance of hospitals by the company is heavy. The labor turnover is high and continued recruiting is necessary. As in most countries where

wages are low; labor is inefficient; much work is done by hand that would be done by machinery elsewhere. The net result is that the labor cost is not exceptionally low, in spite of the low wage scale. The chief article of native food is "mealie" or corn. As suggested by the accompanying picture of a typical worker, clothing is not a serious problem. The climate is as good as can be asked for, according to Mr. Wheeler, who described the operations at a recent meeting of the local section of the Institute. The days, even in summer, are not as uncomfortably hot as in Arizona, and the nights, like those Arizonans describe, are so cool as to make blankets necessary.

The program for the future is to increase output steadily, making use of the smelter until such time as the leaching plant of adequate capacity is in operation. Just what that capacity will be is a matter for future determination. Though it seems unlikely that any great expansion in smelter capacity would be justified, in view of the low metallurgical efficiency it should be remembered that copper in the form of ore is about the cheapest and most abundant thing the company uses in producing an income. It is a wonderful property, but just for interesting speculation, suppose that it were transplanted over night to the south shore of Lake Superior. The line of demarcation between ore and non-ore would promptly drop below 3 per cent copper!

Huge Deposits of Magnetic Iron in Russia

The discovery in Russia of the "richest mine of magnetic iron in the world" has been announced to the French Academy of Sciences by Louis Gentil and M. Plasareff, a member of the Academy of Sciences of Petrograd, who brought to France the documents and surveys regarding the find, according to the *Philadelphia Public Ledger*.

The existence of the field, which is in the Province of Koursk, was first suspected in 1875 through the behavior of compasses in that region. In 1896 the Imperial Geographical Society of St. Petersburg assigned a scientist to find the cause of the anomalies of the compass in that region. Later the Russian physicist Leyst established magnetic charts of the ores.

Then Plasareff took up the task as head of the mission appointed by the new Russian Academy of Science. He found the magnetic anomalies distributed in two parallel bands running northwest-southeast, one of which is 24 miles wide and 150 miles long. All the hypothesis in explanation of this were scientifically demolished, leaving only the theory of the existence of vast fields of magnetic iron.

The expedition then drilled across the sterile strata for a distance of 450 ft. and laid bare a deposit of quartzite 350 ft. meters thick and striated with bands of magnetic iron the thickness of which increased with the depth.

Argument for Copper Tariff Advanced by Michigan Man

R. H. Shields, President of Arcadian Con., Airs Views on Subject—Would "Meet High Cost of Supplies, Labor, and Taxes"

There is some sentiment in the Michigan district for a tariff on copper, sufficient to give American copper a preferred position in the home market. Commenting on this expedient to hasten the return of prosperity in the copper-mining industry, Robert H. Shields, of Houghton, president of Arcadian Consolidated and well-known Republican leader in Michigan, said:

"The demand for copper has greatly increased within the United States, though not elsewhere. But, as an offset to this domestic demand, the production of this metal has very greatly increased outside of the United States, and is going to further increase. As an instance, the mines of South America are producing at the rate of nearly 500,000,000 lb. of copper annually, whereas the production of these same mines ten years ago did not exceed 15,000,000 lb. And according to the best authority, the American market has been compelled to take up this increase.

"Now, since the demand for the metal has not kept pace with this increased production, and may not for years to come, some way must be found to put the copper industry of the United States on a sounder footing. That way is to do what was done under similar conditions many years ago; place a tariff on all copper imported into the United States and so compel foreign mines to meet the high cost of supplies, labor and taxes that prevails here."

S. J. Lewis Finances Purchase of Machinery for Tlaxpampa Mine

S. J. Lewis, president of the San Miguel Tlaxpampa Mining Co., recently returned to Mexico from a trip to New York, where he is said to have been successful in placing a sufficient number of shares for raising the money to install new machinery in the mines, where it is proposed to carry on extensive development work.

The prospects for the mines are very encouraging and general operations are being carried on with regularity. Communication was recently made in the south face of the new tunnel with the old San Miguel Tlaxpampa vein, where rich ore bodies are said to exist.

Florericka Company Reopens Old Properties in Guerrero

The Florericka Mining & Metallurgical Co. is developing the Erika, Flora, and Wonderland mines, in the Media Luna Mountain, about five miles from the Balsa station, State of Guerrero. The Erika and Flora are old properties which have been developed to a considerable extent and are well proved up and produce valuable ores. The Wonderland is a new mine, which is traversed by a wide vein with a good grade of ore, visible on the surface for almost the entire distance across the group of twenty-four claims. The orebodies which have been opened up give an approximate value of 380 grams of silver, 5.6 per cent copper, and one and a half grams of gold. The Florericka company was organized in February of this year under the laws of Mexico with Mexicans and Americans as the principal stockholders and directors. It is estimated by experts that there is 1,000,000 tons of ore practically in sight. Charles R. Cook is president.

Huantla Mines To Be Unwatered

The Corporation Minera de Mexico is unwatering its mining properties in the Huantla district, Morelos, Mexico, preparatory to the extraction of ore. These properties are among the richest in the State of Morelos but have not been worked for a number of years, on account of lack of capital to dewater them.

It is calculated that within a month the water will be lowered to such an extent that samples can be taken and active work commenced in the upper levels.

Michigan Copper Stocks Fairly Small As Navigation Closes

Copper shipments by boat out of the Michigan district in November were heavy. The total, 13,164,000 lb., compared with 8,860,000 for October and 13,160,000 for November, 1922. Calumet & Hecla Consolidated, which includes Ahmeek and Isle Royale, shipped 11,392,000 lb. from the Torch Lake smelter; 1,240,000 lb. left the docks of the Michigan smelter at Houghton, which treats Copper Range, Mohawk, and Wolverine mineral, and Quincy shipped 532,000 lb. Calumet & Hecla and Quincy metal is fairly well cleaned up and both will finish the year with comparatively little copper on hand. November was the last full month for shipment of metal by boat, and as much copper as possible was sent forward to take advantage of the cheaper Lake freight rates. Navigation probably will remain open until Dec. 15, and it is expected a considerable tonnage will be recorded for this half of the month.

Starts Production of Hematite Near Clinton, N. Y.

The Clinton Metallic Paint Co. has just completed a 100-ft., two-compartment shaft near Clinton, N. Y., and production has been started. The ore mined is hematite; it is used in the manufacture of paint and mortar colors.

The hoisting plant is copied directly from the Joplin practise and the advancing long-wall method is to be used in mining. The tonnage to be handled will probably not exceed fifty tons a day. William Spence Black is in charge of the property.

Quapaw Operations Stimulate Interest in Adjoining Fields

Eagle-Picher and Golden Rod Seek Leases on Oklahoma Reservation —Wolverine Mill Starts

Success of the Quapaw Mining Corporation, a Schwab organization, in draining the ground immediately west and south of Quapaw, Okla., has resulted in active demand for leases in this section, which always has been avoided on account of water.

The Eagle-Picher Lead Co., which was unsuccessful in getting any of the acreage to the east of the town of Quapaw when the Quapaw Co. obtained its leases, has made application for about 2,180 acres south of the town. The Golden Rod Mining & Smelting Corporation also has put in an application for 920 acres of leases in the same territory. The applications are made with the Quapaw Indian Agency, at Miami, Okla.

The Quapaw Mining Corporation, which is holding the water below the 200 level on its acreage by pumping only about 3,000 gal. per minute, has placed its Wolverine mill in operation. The Waxahachie Co., to the south of the Wolverine, is sinking its mill shaft and probably will start its plant in operation soon.

Mount Lyell Output 6,000 Tons of Copper During Year

A recent report from Mount Lyell, in Tasmania, states that at the Mount Lyell M. & R. Co.'s North Lyell mine the output remains fairly constant at between 10,000 and 11,000 tons a month. All levels from 700 to 1,100 are maintaining excellent productive value, with the usual proportion of good-grade material coming from the 1,110, 925, and 850 levels. At the Mount Lyell mine the usual tonnage of pyrites is being extracted to provide for smelting and export requirements. It is understood that the output of blister copper for the year ended Sept. 30 was approximately 6,000 tons.

Stratton Mines Co. Organized By $10 Investors in Idaho

The Stratton Mines Co. has been incorporated to take over the McPhillips property, near Wallace, Idaho, upon which a rich strike was made a few months ago. The McPhillips was taken under lease and bond by Stratton, who developed the ore with funds derived from the sale of $10 option certificates. The next step in this novel scheme of financing is the organization of a company with an authorized capital of $150,000, divided into 1,500,000 shares of the par value of 10c. each. Up to Jan. 1 holders of option certificates may exchange them for 250 shares and also exercise the option to purchase 750 additional shares upon the payment of $20 for each certificate. In the meantime about fifty tons of high-grade lead-silver ore has been shipped. It is hoped to be able to ship regularly.

Utah Iron-Ore Shipments Begin

The Columbia Steel Co. is shipping a car of iron ore every other day from its iron mines in southern Utah to Torrance, Calif., and a car of the same ore weekly to Portland, Ore. Ore is also being stored at the mines. This marks the beginning of the productive era of the immense iron-ore deposits of Iron County.

Labor Biggest Element in Mine Development Cost

THE expenditure this year of non-producing development companies and of producing non-dividend paying companies in the Nine Mile Creek watershed of the Coeur d'Alene region of Idaho will be $431,835, according to a survey of twenty-one corporations, made by Ravenel Macbeth, secretary of the Idaho Mining Association. Among properties in this district are the Northwest, Mayflower, North Star, American Success, and Nine Mile.

Of the $431,835 to be expended $272,015 will be for labor, $113,340 for supplies, $18,150 for mine equipment, and $28,330 for mill improvements. Of the total sum $59,740 will be expended by the non-producing development companies, $339,830 by producing non-dividend paying companies, and $23,265 by lessees. The properties concerned are situated in the Nine Mile and Black Cloud gulches and on the east fork of Nine Mile Creek and do not include those on which assessment work only is performed.

Silver King Coalition Ships 1,000 Tons of Ore Weekly

The Silver King Coalition of Park City, Utah, will on Jan. 1 pay its regular quarterly dividend of 15c. a share, amounting to $187,500, and bringing the total paid by the company to over $16,671,000. The Silver King Coalition during the past two months has shipped at the rate of about 1,000 tons of ore and concentrate weekly. Much development work has been done lately, chiefly on the orebodies on the 1,400 and 1,450 levels, which are being followed into new ground. The mine is stated to have more ore in sight than ever before. The new mill is running satisfactorily.

Michigan-Utah Continues Shipments

The Michigan-Utah of Alta, Utah, is shipping at the rate of twenty-eight tons of ore daily over its aërial tramway. A fire on the morning of Dec. 4 destroyed the company boarding house, recently completed to take the place of a similar building destroyed over two years ago. The men will be housed elsewhere, and operations will continue as usual.

Verde Central Will Sink New Three-compartment Shaft

Announcement Follows Election of C. & A. Directors as Verde Central Officials

It has been announced by Thomas Collins, a director of the Verde Central Mining Co. of Jerome, Ariz., that his company will start immediately sinking a new three-compartment shaft. It is proposed to make the new shaft a main working way and complete it to the 1,500 level at once. Grading and construction of the collar will be started immediately, and sinking will be under way as soon as possible. The new working will be located southeast of the present shaft, and it will be equipped with a steel headframe and a hoist that was formerly in use at the Gadson property which is capable of lifting from a depth of 3,000 ft.

The Verde Central has been carrying on development work from a small inclined prospect shaft on the 800 to 1,000 levels during the current year, and there have been continued reports of the success of this work. The announcement of the proposed construction emphasizes the importance of discoveries that have been made and justifies the conclusion that development at greater depth will be possible, which could not have been carried on satisfactorily from the present shaft.

The Calumet & Arizona Mining Co. is largely interested in Verde Central, and the decision to construct a new shaft is announced after a recent visit of its officials to the property.

Royal Development Co. Extends Trinity Tunnel in Washington

The Royal Development Co., operating in Chelan County, Wash., near Wenatchee, has recently completed a new power plant which develops 500 hp. and is driving the long Trinity tunnel, which is to tap the dike which contains low-grade ore reported as averaging about 2½ per cent copper, with gold and silver values. According to the reports of James Naughten 267 ft. of ore has been cut in upper workings and the Trinity tunnel is projected to cut the extension of this shoot at 1,000 ft. lower depth. Work will be continued all winter.

C-K Copper Co. Finds Chalcocite in Arizona Prospect

The C-K Copper Co. has located a copper prospect in the Mineral Park district near Chloride, Ariz. A shaft was sunk 60 ft. by the side of a wash and encountered kaolinized porphyry in which were stringers of chalcocite. A short drift was extended into the formation, and the sampling of the drift was sufficiently encouraging to warrant the sinking of a second shaft 205 ft. away from the first. The same formation was encountered, the fracture planes being mineralized with chalcocite. The importance of the strike cannot be fully determined without further prospecting.

New Development at Grass Valley

In the Nevada City and Grass Valley district in California the Mayflower mines, comprising a group of claims on Canada Hill, has a small force of miners driving a tunnel. The property was recently bonded by F. B. Chapman, of Los Angeles. The Tonopah North Star and Umatilla companies have started development at the Gold Mound and Olympus claims. At the Ben Franklin two shifts per day are at work preliminary to further shaft sinking and development.

California Gold Dredge Census Show Twenty-six Busy

A recent count of the gold dredges in operation in California indicated about twenty-six at work. Four of these are in Trinity County, on the Trinity River; four in Shasta and Butte counties; Natomas is operating eight boats, of which two are in the Oroville district and six at Natoma; the Yuba Consolidated Gold Fields is operating five boats and the Marysville one boat on the Yuba River; one boat is operating at Jenny Lind and another at La Grange, one at Oroville, and one on the American River.

Tamarack Tailing-Treatment Plant To Be Ready By Spring

Judging by the present rate of progress, the Tamarack reclamation plant of Calumet & Hecla Consolidated, in Michigan, which will reclaim the copper from the conglomerate sand in Torch Lake, will be finished by spring. Practically all outside work has been completed, and the installation of settling tanks and regrinding units is under way. The dredge, which will scoop up the sand, is under construction and will soon be ready for installation of machinery. The Tamarack plant is designed to produce about 850,000 lb. of refined copper per month. Its capacity is about 50 per cent of the Calumet & Hecla plant. A recovery of fully 10 lb. per ton is expected from the Tamarack sand.

West End Leases Tonopah "76" Property

The West End Mining Co., of Tonopah, Nev., has secured a long-term lease on the property of the Tonopah "76" Co., and work has been resumed where it was left off about six months ago. Previous arrangement with the West End company provided for the payment of development expense in Tonopah "76" stock, and when the treasury stock was exhausted work ceased, until the present lease was signed. The work is being done on the 800 level from the Ohio shaft of the West End company. Conditions are regarded as promising for the finding of ore; in fact, several small stringers of high grade had been cut in the crosscuts just before work ceased under the previous agreement.

News from Washington

By PAUL WOOTON
Special Correspondent

Producers and Importers Argue Magnesite Tariff

Allege California Product Is Not Uniform—Current Output in Washington Low—Imports in 1923 Decreased—Domestic Product Competes as Far East as Chicago

TESTIMONY for and against a reduction of duty on magnesite under the terms of the flexible tariff, on application of one Czechoslovakian producer and four Austrian producers, was heard by the Tariff Commission on Dec. 5, despite absence of any representative of the applicants. The present duty is $\frac{1}{8}$c. per pound of crude and $\frac{1}{4}$c. per pound of calcined material.

Witnesses before the commission were George W. Selby, of Philadelphia, representing the Magnesite Cement Building Products Association, and Henry A. Golwynne, of New York, the largest individual importer of caustic calcined magnesite, who advocated reduction in the duty; and Stanley H. Barrows, of Chicago, president of the Seirra Magnesite Co. of Porterville, Calif.; Nelson Franklin, of Washington, representing the Northwest Magnesite Co.; and F. E. Schundler, of Joliet, Ill., representing the Western Magnesite Development Co., whose producer is C. S. Maltby of California, these three opposing a reduction.

Mr. Selby stated that the consumption of caustic magnesite is increasing because of its growing use in stucco work and in floorings. Personally, he said, he preferred the imported magnesite, either from Greece or India, to the California product and paid a premium for the imported because of its more uniform high quality, although he stated that some of the California product is fully equal to the imported. Unless the tariff is reduced, magnesite cement manufacturers may be forced to use the California magnesite and some lowering of quality of the cement may result, he said. His greatest objection to the domestic product was irregular quality, Mr. Selby stated. This witness urged a reduction in the duty on caustic magnesite for the benefit of the consumers.

Mr. Golwynne, who said that this year he has imported 59 per cent of the caustic magnesite brought into the United States, all of his product coming from India, presented figures of his costs at the mine at Salem, India, through the various stages of transportation and duty until landed at New York, and also gave freight rates to interior points, with comparisons of rates from the Pacific Coast, in an effort to establish that domestic producers now enjoy decided advantage.

No witness appeared in behalf of importers or consumers of dead-burned magnesite, for refractory purposes, which forms 71.8 per cent of total consumption of magnesite in the United States, according to the Tariff Commission's figures.

Mr. Franklin, whose company, operating in the State of Washington, is the principal domestic producer of dead-burned magnesite, testified that the Northwest Magnesite Co. did not operate in 1921 or 1922, because of foreign competition, although its methods are the last word in economy. Last February it started three of its five furnaces, he testified, but since June has been operating only one furnace. In reality, he said, there should be an increase in the tariff, although he was not asking for it and was hopeful that conditions of demand would become such that his company could get all furnaces in operation and thus test the tariff protection under conditions of full output.

The quality of California caustic magnesite was defended vigorously by both Mr. Barrows and Mr. Schundler. Mr. Barrows declared that though a few years ago during the experimental stage there may have been some cause for complaint regarding irregular quality, this has been removed and now the product is shipped equal if not superior to the foreign caustic magnesite, in color as well as in other factors. It is neither over-burned nor under-burned he said. The test of this is the entire satisfaction of many consumers of the California magnesite, he said.

In a summary of information on this case, the staff of the Tariff Commission reported reserves of 24,322,000 net tons of crude ore, 1,422,000 in California and 22,900,000 in Washington, which at the average consumption of the last twelve years would be sufficient for eighty-five years, without imports. Domestic production for nine months of 1923 under the present tariff was estimated at 125,000 tons, compared with 63,487 tons in all of 1922. Imports for nine months of 1923 were given as 104,579 tons, compared with 232,314 tons in 1922.

The summary has this paragraph:

"In conclusion, it may be said that domestic dead-burned magnesite during 1923 is apparently on a competitive price footing with the foreign product up to a point slightly east of Pittsburgh, but not at the Atlantic Coast. Caustic magnesite, on a price basis only, could hardly compete with the foreign product east of the Mississippi; but integration of the industry with that of stucco manufacture and consequent improved selling organization has permitted competition somewhat farther east than Chicago."

Secretary Work Explains Suspension of War Minerals Payments

Outstanding Claims $3,333,341; Fund $1,876,333—Mandamus Renews Claims Once Denied—Congressional Action Likely Necessary to Adjust Matter

IN VIEW of the prospect of early consideration by Congress of the war minerals relief situation, unusual interest attaches to the report made to Congress by the Secretary of the Interior covering the administration of the act from Dec. 1, 1922 to Dec. 1, 1923. He also summarizes the earlier administration of the act. With regard to the temporary suspension of payments, Secretary Work says:

"The act contains the express mandate that the awards and the administration cost shall not together exceed the amount appropriated for the settlement of all claims. In the early administration period, claims were paid in full, in the belief, which seemed justified, that the fund was ample to meet the drafts which would be made upon it. There could be no reason for withholding from needy claimants any part of the money which it was found was due them under the act so long as there was no reason to doubt that the appropriation was sufficient. In October of the present year, after a great many claims had been adjusted, and after application for rehearing had been filed in other claims which theretofore had been regarded as abandoned, there was created for the first time a reasonable doubt that all claims which finally would be presented could be paid in full and not exceed the amount of the appropriation. On Oct. 13, it was decided that proper and lawful administration required the withholding of further payments until such time as the sufficiency of the appropriation to meet allowable losses in full could more definitely be determined, the work of investigation of claims and ascertainment of net losses to proceed meantime without interruption and with due dispatch. The present unexpended balance of the appropriation ($1,876,333.59), as given in this report, of course takes into account all claims wherein net loss has been determined by the Secretary even though awards in all have not actually been promulgated, as the finding of net loss causes them to be an incumbrance on the fund.

"At the present time there remain for adjudication 204 open or live claims; that is, claims which have been prosecuted with more or less diligence and which are entitled to consideration. The amount asked in these claims is $3,333,341.33. The remainder of the appropriation at the present time is $1,876,333.59. Whether the number of open claims will be increased much or little depends upon the action that shall be taken upon those claims which are not regarded as open claims.

"When the work of adjusting claims was begun, under the original act, it was found that claimants were asking to be reimbursed for the purchase price of mines and leases, and for interest paid on borrowed capital. The then Secretary of the Interior held that Congress did not intend that losses involved in the acquiring of title to real property, or interest paid by those who were without capital of their own, should be repaid, and that decision has been adhered to universally.

"It was the departmental view that the legislative history of the War Minerals Relief Act left no doubt that reimbursement for the purchase price of real estate was not intended, a plain provision for such reimbursement having been stricken from the bill; and that if interest on borrowed capital were to be allowed claimants who operated on borrowed capital, then interest should be allowed to claimants who took the greater risk of investing their own money. To allow interest on invested capital meant the allowance of profit, for interest means profit, and the act specifically prohibits the allowance of profit to any claimant.

"In January, 1923, one Logan Rives brought an action in the Supreme Court of the District of Columbia against the Secretary of the Interior, seeking a writ of mandamus to compel the Secretary to consider and allow his claim in so far as it was based upon a purchase of mining property made by him. In April, 1923, the court sustained the relator's view and awarded a writ against the Secretary. An appeal was taken to the Court of Appeals, where the case was argued in October. That court has not yet rendered its decision.

"In July, 1923, an action was brought by the Chestatee Pyrites & Chemical Corporation for the securing of mandamus to compel the Secretary of the Interior to include as money due it under the act, the amount expended for interest on borrowed capital. The case was argued in October and is still under advisement by the court.

"If these suits ultimately shall be decided in favor of relators, the question necessarily must find its way to Congress, for, in that event, a very large additional appropriation will be required. In the present situation, the courts' decisions, if they should hold purchase price of property and interest on loans to be admissible, would be nullities, because there would not be the money with which to carry the judgments into effect."

Federal M. & S. Co. Will Prospect Fringe of Picher District

An attempt to locate orebodies outside the well-defined Picher area, in the Joplin-Miami zinc district, is to be made by the Federal Mining & Smelting Co. It recently obtained leases on about 1,400 acres of land on Four Mile Creek, about four miles west of Picher. Drill rigs are being moved to the property preparatory to thorough testing.

The company also is drilling out a tract of 240 acres just north of Empire, near Galena, Kan., and a 40-acre tract just south of the Hartley mill of the Chanute Spelter Co.

November Established New High Record for Copper Sales

THE month of November established a new high record in the copper industry, so far as shipments from refineries to both domestic and foreign consumers are concerned, according to figures made public in trade circles. Total shipments for the month aggregated 224,000,000 lb., and compare with a previous record of 208,000,000 lb., established last March. November is the fourth consecutive month in which shipments were more than 200,000,000 lb. It is unfortunate that these large shipments come at a time when the metal is selling only a little above the low record for the current year, and consequently only the lowest-cost producers are making a fair profit on the business now being handled. Shipments for foreign account last month are estimated at 96,000,000 lb., which is just short of a peace-time record. The total compares with average monthly shipments of 63,000,000 lb. in the first six months of the year, the increase, as the figures show, being a consequence of improved buying abroad.

Secretary of Interior Transfers Funds to Start Silver Research

Research looking to the development of additional uses for silver has been begun by the U. S. Bureau of Mines. In order that the work may start at once, the Secretary of the Interior has transferred to the Bureau of Mines $4,000 from his reserve fund. He also has authorized a supplementary estimate calling for $15,000 for the continuance of the work during the next fiscal year.

In a letter to Senator Oddie, of the Senate Commission of Gold and Silver Inquiry, Secretary Work reveals that the government's funds will be supplemented through the co-operation of the silver industry.

L. I. Shaw, who has been serving the Bureau for a number of years as assistant chief chemist, has been detached from the Division of Mineral Technology and transferred to the Division of Metallurgy to take immediate charge of the work. His entire time will be devoted to the silver research. Other members of the technical staff will be assigned to this work when the necessary funds are available and as the scope of the inquiry expands.

Dr. Shaw's first work will be to assemble the information already in the hands of the government. It is known that the Bureau of Standards has done important work in connection with the prevention of tarnish on silver. It is probable that the Bureau of Standards will participate in some phases of this research.

London Letter

By W. A. Doman

Special Correspondent

London, Nov. 29—It is questionable whether any other mining company gives its shareholders such full information as the Burma Corporation. Its operations are conducted on a vast scale, and the reports of the manager, P. E. Marmion, cover every branch. Safely may it be asserted that if investors were always treated so considerately there would be less grumbling when a company fails. There is, of course, the other side of the question. The ordinary member of the public who puts his savings into mining ventures cannot always understand what is set before him, and consequently the expense of printing and circulating reports is claimed to be unwarranted. Only by examining such a long report as that issued by the Burma Corporation is it possible to get an idea of the complex machinery necessary for ore and metal winning on a large scale.

Labor Situation in Burma Improved

But apart from this aspect the company does untold good to the natives by treating them medically at its hospitals. The report just issued covers a period of eighteen months to June 30 last, and shows a very satisfactory state of affairs. Twelve months ago labor was a serious problem. Even now it causes anxiety, but the position in this respect is greatly improved. Short-time migratory workers cannot be made efficient, and in order to induce longer terms of service, health conditions have been studied, and many of the natives have their families living with them on the property. Every other problem apparently can be satisfactorily solved. The report and accounts are separated into one period of twelve months and one of six months, and the latter mentions progress in various directions in advance of that of 1922 over 1921.

Dividend Paid by Burma Corporation

Efficiency has increased, operating costs have been reduced, and the percentage of extraction of metals is higher. For the calendar year 1922 there was a profit of £283,474, against £167,432 in 1921, and for the first half of the current year the net profit was £208,584. A dividend of 4 annas has been paid and a like amount is to be declared at the meeting.

The value of the ore opened up shows remarkable consistency. At June 30 last the estimate was 4,511,909 tons assaying 22.8 oz. silver, 25.3 per cent lead, and 16.9 per cent zinc, compared with 4,555,069 tons assaying 22.9 oz. silver, 25.4 per cent lead, and 17.1 per cent zinc, at Dec. 31, 1922. Development shows that the zinc content of the ore is decreasing, and this simplifies its metallurgical treatment, with the result that increased recoveries of lead and silver at reduced costs can be expected, the combined effect of which will offset loss of zinc value.

Brisbane Letter

Special Correspondence To "Engineering and Mining Journal-Press"

Brisbane, Nov. 5.—E. C. Saint-Smith, a government geologist, has sent in a preliminary report on the big silver-lead discovery at Cloncurry, now called the Mount Isa. He says that, whereas the Chillagoe deposits, found a short time earlier, is a lode, the Mount Isa is a field. The silver-lead lodes opened up on this field at the time of the geological examination are distributed over a total length of five miles by a width of one mile. The strata in which they occur consists of laminated clay shales and slates, sandstones, quartzites and cherts, and jasperiod quartzites and slates, belonging to what are known as the Cloncurry series and believed to be pre-Cambrian in age. The common form of occurrence is for the lead mineral to exist as narrow bands, but with usually thicker seams where a couple of feet of "country" separates the bands.

"Cannot Restrain Enthusiasm," as Becomes Official

Five distinct ore channels at least are traceable over the field. So far, they have been opened up merely by open cuts put into the outcrops, and no exploration at depth has been attempted. High values in both lead and silver have been obtained. Two assays from one holding gave the very good results, respectively, of 62.30 per cent of lead, with 1,960 oz. of silver per ton of ore, and 62.40 per cent of lead, with 2,090 oz. of silver to the ton. The geologist speaks of the very large tonnage of ore that is already definitely in sight, and concludes his report in these words: "I was so greatly impressed with both the future possibilities and present value of this field that it becomes a difficult matter for me to use language sufficiently restrained for an official report. Suffice it to say that I am firmly of the opinion that a drilling campaign will confirm the optimistic opinion that this discovery will soon prove to be perhaps the most important find of metal made in the commonwealth for the past decade."

State Metal-Mining Ventures Loose

As far as is at present known, all the important state mining undertakings in Queensland except the Bowen coal mine are being carried on at a loss. In addition to the big deficiency lately disclosed in the working of the Chillagoe State smelters, the Irvinebank treatment works show an accumulated loss of £32,665; the Bamford battery, near Chillagoe, has "gone to the bad" to the extent of nearly £15,000, and further losses have been incurred on State batteries at Kidson, on the Oaks gold field, and at Charters Towers. The state arsenic mine is also still showing a loss, as are also two of the government collieries. The government defend losses on these undertakings by pointing to the benefit conferred upon the workers and the public.

When work at Mount Morgan was resumed in March, 1922, after a year's stoppage, the government, in order to prevent more than a slight decrease in the wages of the employees, agreed to grant the company a rebate in railway freights up to £1,100 per week. In the last financial year these rebates have amounted to nearly £46,000, and from March, 1922, to date have totaled £58,-854. In spite of this assistance, the Mount Morgan company is still carrying on at a heavy loss.

Stinnes Wants Swedish Zinc Mines

Information has come to hand from Gothenburg stating that Hugo Stinnes is endeavoring to acquire the zinc mines of Northern Sweden. There are other competitors for the properties, consisting of British, Dutch, and French capitalists.

Ore-pickers in the New State Areas mill, on the Rand, in South Africa

THE MARKET REPORT

Daily Prices of Metals

Dec.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
6	12.875	47.375	47.875	7.30	7.125@7.25	6.25@6.275
7	12.875	47.00	47.50	7.30	7.25	6.25@6 275
8	12.875	46 50	47.00	7.30	7 25	6 25@6.275
10	12 90	45.675	46.125	7.30	7.25	6.25@6.275
11	12.90	45.875	46.375	7.30	7.25	6.25@6.275
12	12.90	47 25	47.75	7.30	7.25	6.20@ 6.25
Av.	12 888	46.613	47.104	7 30	7.240	6 256

*These prices correspond to the following quotations for copper delivered: Dec. 6th, 7th, and 8th, 13.125c.; 10th, 11th, and 12th, 13.15c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Dec.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
6	62 1/4	63	67 1/4	238 3/4	239 7/8	30 7/8	29 1/8	32 1/2	32 3/4
7	62 5/8	63 1/4	67 3/4	238 1/2	239	30 5/8	28 7/8	32 1/2	32 3/4
10	62 3/4	63 1/2	68 1/4	230 1/2	231 3/4	31 1/8	29 1/4	32 1/4	32 3/4
11	62 3/8	63 1/8	67 1/2	229 1/2	230 3/4	31 1/4	29 3/8	32 1/4	32 3/4
12	62 1/4	63	67 1/2	237 1/4	238 1/2	31 3/8	29 3/4	32 3/8	32 3/4

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Dec.	Sterling Exchange "Checks"	Silver		Gold London	Dec.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
6	4.38	64 5/8	33	94s 0d	10	4.35 1/2	64 1/2	33 1/16	94s 7d
7	4.36	64 1/4	33 1/16	94s 9d	11	4.37 1/4	65 1/8	33 7/16	94s 5d
8	4.35 5/8	64 1/2	33 3/16	.....	12	4.38	65 1/4	33 1/4	94s 1d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, Dec. 12, 1923

Copper

The copper market is in much the same condition as last week, with no established price level. Most of the large producers are asking 13.25c. delivered, and several million pounds have been sold at that level, mostly for delivery over the first quarter of the year. The custom smelters in general are asking 13⅛c. delivered, and several lots have been disposed of at that price; at least four sellers continued to quote that figure today and found no rush to buy. Also, some copper has been sold for as low as 13c. delivered, this being either for immediate delivery or where the freight rate was exceptionally low.

The statistics for the month of November are regarded as more favorable than was expected. It is said in well-informed circles that domestic deliveries were 128,000,000 lb., and foreign shipments, 96,000,000 lb., making a total of 224,000,000 lb., the highest record made this year, the next highest being in March, when 208,000,000 lb. was shipped. Production in North and South America during November is given as 214,000,000 lb., the stocks thus being decreased by 10,000,000 lb. Stocks of refined copper are now probably about 262,000,000 lb., which is considerably less than two months' supply. The amount of blister and copper in process of refining is about 450,000,000 lb.

The export market has been quiet during the last week, though there was fair activity in the last two or three days, the French bookings being particularly encouraging yesterday. Prices realized have been approximately 13.30c., c.i.f.

Lead

The American Smelting & Refining Co. has made no change during the week in its official contract price of 7.25c., New York. Most all the lead that has been sold has been on that basis, or at average prices. December shipment lead is so scarce in both the New York district and in the Middle West that the fancy prices quoted are almost entirely nominal. Prompt lead has sold as high as 7⅛c. St. Louis and 7⅜c. New York during the week, but the tonnages involved have been so small that too much weight should not be given to these prices. Some producers are entirely sold out of their expected production for both December and January, and in several instances production will not be so great as sales managers had expected. The high prices for lead do not seem to be increasing the supply. Revolutionary activities in Mexico do not yet seem to have interrupted the lead production there, but some of the Mexican producers may be interfered with, either in their operations or in securing necessary materials and supplies.

Consumers are generally well provided with lead for their immediate requirements, and are in no danger yet of being compelled to curtail operations owing to a scarcity of raw material for manufacture.

Zinc

Zinc prices held remarkably even during the week, at 6.25c. for prompt and 6.275c. for forward delivery, the tonnage sold being approximately evenly divided over the next three months. Today, the market was a trifle weaker owing to the desire of some producers to market their current output.

Statistics compiled by the American Zinc Institute show 44,280 tons of zinc produced in the United States during November, and 39,163 tons shipped: the stocks thus increasing from 25,787 tons to 30,904. This was about what was expected, and as stocks are not yet large enough to cause any worry,

the effect of the statistics on the market has been negligible. The amount shipped from plant for export was 2,123 tons. The number of retorts operating Nov. 30 was 84,906.

Tin

Consumers were quite active buyers on Monday and Tuesday, when prices showed a pronounced drop. Today the tendency is again upward, and at the close 48c. was about the best that could be done. Little or no American electrolytic tin is now being offered, production being suspended. Forward tin has sold at from one-eighth to one-quarter cent less than spot Straits.

Arrivals of tin, in long tons: Dec. 1st, Australia, 40; Hamburg, 25; Straits, 25; 3d, Straits, 600; 4th, London, 325; Straits, 1,125; China, 35; Liverpool, 25; Hamburg 25; 5th, Straits, 50; 7th, Straits, 1,025; China, 25; 10th, Straits, 200; 11th, Java, 150; total to Dec. 11, 3,675.

Foreign Exchange

On Tuesday, Dec. 11, cable quotations on francs were 5.3875c., and on lire, 4.375c. Canadian dollars, 2 1/32 per cent discount.

Silver

Silver prices have risen above the net London parity, owing to the recent developments in Mexico. On account of the insurrection in that country, railroad communication from the interior to border shipping points has been interrupted, with the result that deliveries contracted for by certain dates have been delayed. This has caused a shortage of spot supplies with a consequent advance in price.

Mexican Dollars—Dec. 6th, 49¼; 7th, 49; 8th, 49¼; 10th, 49¼; 11th, 49⅜; 12th, 49⅜.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum — 99 per cent grade, 27c. per lb.; 98 per cent, 26c. London, £115 per long ton.

Antimony — Chinese and Japanese brands, 8¾@9c. W.C.C. brand, 9½@10c. Cookson's "C" grade, 10¾@11¼c. Chinese needle antimony, lump, nominal, 6½@7½c. per lb. Standard powdered needle antimony (200 mesh), 7@8c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 7.50c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium—75c. per lb. London, 2s. 6d.

Cobalt—$3 per lb. for spot.

Iridium—$275@$300 per oz.

Nickel—27@30c. per lb. for 99 per cent virgin metal. London, £130 long ton.

Palladium—$83 per oz.

Platinum—$125 per oz. London, £29.

Quicksilver — $60 per 75-lb. flask. Quiet. San Francisco wires $60.35. London, £9 15s.

The prices of Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Selenium, Tellurium, Thallium, and Tungsten are unchanged from prices given Dec. 8.

Metallic Ores

Manganese—38@42c. per long ton unit, seaport, plus duty. Nominal.

Chrome—$19.50@$24, depending upon grade and source. Nominal.

Tungsten Ore—High-grade wolframite, $9; high-grade scheelite, $9.50@$10 per unit. Ordinary grades, $8.15@$8.50.

Iron Ore, Magnetite, Molybdenum, Titanium, Vanadium, and Zircon Ore are unchanged from the quotations published Dec. 8.

Zinc and Lead Ore Markets

Joplin, Mo., Dec. 8—Zinc blende, per ton, high, $43.80; basis 60 per cent zinc, premium, $41.50; Prime Western, $40.50 @$41; fines and slimes, $39@$37.50 average settling price, $41.63.

Lead, high, $90.20; basis 80 per cent lead, $83@$93; average settling price, $83.79 per ton.

Shipments for the week: Blende, 16,448; lead, 1,650 tons. Value, all ores the week, $822,970.

Neither buyers nor sellers would report the highest basis price for lead ore, but the high basis was given at $87.50 last week, and it is now reported that considerable of the tonnage was purchased on $90 basis. Though no exact information is made public, it is given out that higher than $90 basis is to be paid for ore purchased this week.

Zinc purchases were increased, with 17,130 tons sold this week.

Platteville, Wis., Dec. 8.—Blende, basis 60 per cent zinc, $43.50 per ton. Lead, basis 80 per cent lead, $90 per ton. Shipments for the week: Blende, 593 tons; lead, 30 tons. Shipments for the year: Blende, 29,912; lead, 750 tons. Shipments for the week to separating plants, 749 tons blende.

Non-Metallic Minerals

Asbestos—Crude No. 1, $350@$450; No. 2, $200@$250; spinning fibers, $100@$125; magnesia and compressed sheet fibers, $60@$90; shingle stock, $50@$60; paper stock $30@$40; cement stock, $17@$20; floats, $6@$12. **All f.o.b. mines, per short ton, Quebec.**

Feldspar—No. 1, $6.60 per long ton, f.o.b. cars; No. 2, $4.50; ground spar, glass trade, $10, f.o.b. mill; pottery grade, $18 per long ton, North Carolina points.

For other feldspar quotations see issue of Dec. 8th.

Mica—Scrap, $20 per ton; washer, 11c. per lb.; disk, 1½ in., 30c. per lb.; 2x2 in., 55c.; 2x3 in., 80c.; 3x4 in., $1.05; 3x5 in., $1.60; 4x6 in., $2 per lb., North Carolina mines.

Barytes, Bauxite, Beryl, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Fluorspar, Fuller's Earth, Garnet, Graphite, Gypsum, Limestone, Magnesite, Manjak, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc and Tripoli are unchanged from the Dec. 8 prices.

Mineral Products

Arsenious Oxide (white arsenic)— 13½c. per lb.

Copper Sulphate—4.75@4.90c. per lb., domestic product.

Potassium Sulphate—Basis 90 per cent, $45.85 per ton.

Sodium Sulphate—$24@$26 per ton, New York.

Sodium Nitrate—$2.45 per 100 lb., ex vessel.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, generally obtainable at $109 per gross ton, f.o.b. works. Spiegeleisen, 19@21 per cent, $40; 16@19 per cent, $38.50.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and Ferrovanadium are unchanged from the prices published Dec. 8.

Metal Products

Copper—Sheets, 21c. base; wire, 15¾c.

Lead Sheets—Cut, 10.50c.; full, 10.25c. per lb.

Nickel Silver—18 per cent Grade A sheets, 28c.

Yellow Metal — Dimension sheets, 18.75c.; rods, 15.75c.

Zinc Sheets—Base price, $9.25 per 100 lb., f.o.b. plant.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick and Zirkite are unchanged from the Dec. 8 prices.

The Iron Trade

Pittsburgh, Dec. 11, 1923

Steel prices are holding well, and in sheets, where there have been some irregularities for four months, the market grows steadier week by week. It is now altogether probable that the 5.35c. base price on automobile sheets will hold.

Throughout the steel trade, among sellers and buyers alike, there is much more confidence in the market. During 1924 there may be some steel price, but breaks or large declines are not expected. Tonnage output will be somewhat less than in 1923, which with about 43,000,000 tons of ingots, is 35 per cent above the average of the four preceding years.

The Steel Corporation's unfilled obligations decreased by 304,241 tons in November, the smallest decrease since April. From October to November shipments declined somewhat more than bookings.

Pig Iron.—The market is quiet, but prices are steady, at above the recent low point, and with furnaces more or less sold up for first quarter. Bessemer, $23; basic, $21; foundry, $22, f.o.b. Valley furnaces, with $1.76 freight to Pittsburgh.

Connellsville Coke.—Prompt furnace coke, $4 a week ago, is easier at $3.85@$4. Recently contracts for good coke for first quarter were made at $4.40, but the going quotation on standard furnace is nearer $4.25, with furnaces slow to close.

Freight Rates on Metals, Ores, and Concentrates

In Carload Lots

Copper Bullion and Refined Copper

From	To	Rate per Ton of 2,000 Lb. All Rail	Via Gulf
El Paso, Tex.	Baltimore, Md.	(*b*) $11.40*	$10.00*
Garfield, Utah	Perth Amboy, N. J.	12.50	.....
Garfield, Utah	San Francisco	5.85	.....
Hayden, Ariz.	Perth Amboy, N. J.	16.50	$12.50
Miami, Ariz.	Perth Amboy, N. J.	16.50	12.50
Anaconda, Mont.	Perth Amboy, N. J.	12.50	.....
Butte, Mont.	Perth Amboy, N. J.	12.50	.....
Humboldt, Ariz.	Chrome, N. J.	16.50	12.50
Douglas, Ariz.	Perth Amboy, N. J.	16.50	12.50
Globe, Ariz.	Perth Amboy, N. J.	16.50	12.50
Clifton, Ariz.	Perth Amboy, N. J.	16.50	12.50
Clarkdale, Ariz.	Chrome, N. J.	16.50	12.50

From	To	Rate per Ton of 2,000 Lb. All Rail	Via Gulf
Copperhill, Tenn.	Laurel Hill, N. Y.	$10.80	.....
Tooele, Utah	Chrome, N. J.	12.50	.....
McGill, Nev.	Baltimore, Md.	15.90	.....
Houghton, Mich.	New York	(*a*) 9.60	.....
Hancock, Mich.	New York	(*a*) 9.60	.....
Hubbell, Mich.	New York	(*a*) 9.60	.....
Dollar Bay, Mich.	New York	(*a*) 9.60	.....
Tacoma, Wash.	New York Conference rate $6.00 via Canal		
Anaconda, Mont.	Tacoma, Wash.	7.09	.....
Ajo, Ariz.	New York	16.50	*$12.50

(*a*) Applies April 1 to Nov. 30 of each year.
(*b*) Applies Dec. 1 to April 1.

Lead Bullion; (Pig Lead Where Shown)

From	Rates per Ton of 2,000 Lb. To New York	To St. Louis
East St. Louis, Ill.	$7.00	.....
Pueblo, Colo.	14.15	$9.65
Leadville, Colo.	16.50	11.40
East Helena, Mont	16.50	11.40
El Paso, Tex.	*10.00 Via Gulf	
	(*c*) 14.00 All Rail	(*b*) 7.76½
Omaha, Neb.	9.60	3.65
Murray, Utah	16.50	11.40
Midvale, Utah	16.50	11.40
Tooele, Utah	16.50	11.40
East Chicago, Ill.	6.40	(*a*) 2.00
Kellogg, Idaho	16.50	11.40
Carnegie, Pa.	3.80	(*a*) 5.00
Selby, Calif.	(*d*) 6.00	.....
Herculaneum, Mo.	(*a*) 8.80	(*a*) 1.80
Federal, Ill.	7.00	(*a*) 1.80
Collinsville, Ill.	7.00	(*a*) .75½
Granby, Mo.	(*a*) 10.50	(*a*) 3.50
Joplin, Mo.	(*a*) 10.50	(*a*) 3.50

(*a*) Pig lead only.
(*b*) Pig lead only when originating in Mexico.
(*c*) Shipments of bullion originating in Mexico, $2 per ton less.
(*d*) Conference rate, via canal.

Slab Zinc

From	Rates per Net Ton to E. St. Louis	New York
Donora, Pa.	(*a*) $4.60	$3.80
Langeloth, Pa.	(*a*) 4.60	3.80
Palmerton, Pa.	7.10	3.00
Hillsboro, Ill.	1.40	7.00
Danville, Ill.	2.00	6.40
La Salle, Ill.	2.00	6.70
Springfield, Ill.	3.00	7.00
Cleveland, Ohio	5.80	5.00
Moundsville, W. Va.	4.40	3.80
Van Buren, Ark.	3.80	10.80
Fort Smith, Ark.	3.80	10.80
Bartlesville, Okla.	3.50	10.50
Blackwell, Okla.	3.80	10.80
Henryetta, Okla.	3.80	10.80
Sand Springs, Okla.	3.80	10.80
Cherryvale, Kan.	3.50	10.50
Black Eagle, Mont.	9.40	12.50
Park City, Utah	9.00	12.50

(*a*) To St. Louis, Mo.

Zinc Ores and Concentrates

To	From	Rate per Net Ton
Bartlesville, Okla.	Altoona, Kan.	$2.10
	Pittsburg, Kan.	1.09
	Galena, Kan.	1.30
	Joplin, Mo.	1.40
	Iola, Kan.	1.09
	Baxter, Kan.	1.40
	Miami, Okla.	1.40
	Quapaw, Okla.	1.40
	Kansas City, Mo.	1.60
Sand Springs, Okla.	Miami, Okla.	2.20
	Quapaw, Okla.	2.20
	Galena, Kan.	1.50
	Joplin, Mo.	1.50
	Iola, Kan.	2.40
	Cave Springs, Mo.	2.00
	Cent City Spur, Mo.	2.00
Dewar, Okla.	Chitwood, Mo.	2.00
Kusa, Okla.	Galena, Kan.	1.50
Henryetta, Okla.	Iola, Kan.	2.40
	La Harpe, Kan.	2.40
	Mound City, Kan.	.50
La Harpe, Kan.	Oswego, Kan.	.50
	Parsons, Kan.	.50
Coffeyville, Kan.	Galena, Kan.	1.10
	Joplin, Mo.	1.22
	Baxter, Kan.	1.80
Bartlesville, Okla. (*a*)	Miami, Okla.	1.80
	Quapaw, Okla.	1.80

(*a*) Lead ore and concentrates.

Rates on Ores and Concentrates

From	To	Value of Product $5	$10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
		Rate														
Butte, Mont.	Anaconda, Mont.	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17	17	.17	.17	.17
Butte, Mont.	Black Eagle, Mont. (*a*)	....	....	....	....	....	....	....	1.01	....	....	....	....	....	....	....
Great Falls, Mont.	East Helena, Mont.	....	....	1.57	....	1.76	....	1.98	....	2.43	....	....	....	....	....	2.55
Butte, Mont.	East Helena, Mont.	....	....	1.17	....	1.46	....	1.69	....	2.03	....	....	....	....	....	2.14
Paxton, Calif.	Salt Lake Smelters, Utah	....	....	....	....	....	....	....	....	6.30	7.00	7.70	....	8.35	8.60	8.85
Johannesburg, Calif.	Selby, Calif.	....	....	....	2.90	....	3.50	....	4.10	4.70	5.30	5.90	....	6.50	6.80	7.10
Johannesburg, Calif.	Humboldt, Ariz.	....	....	....	3.40	....	4.10	....	4.80	5.50	6.20	6.90	....	7.60	8.00	8.30
Fioche, Nev.	Humboldt, Ariz.	....	4.50(*c*)	7.74	....	8.55	....	9.36	....	.99	....	....	11.25	....	....	12.42
Creede, Colo.	Durango, Colo.	....	....	3.25	3.50	3.75	4.00	....	4.25	4.75	5.25	5.75	6.05	....	....	7.10
Ouray, Colo.	Durango, Colo.	....	....	4.30	4.80	....	5.05	....	....	5.90	....	6.30	....	....	....	7.70
Kokomo, Colo.	Durango, Colo.	....	6.00	....	....	6.50	7.20	....	....	....	....	....	....	....	....	....
Telluride, Colo.	Durango, Colo.	....	....	....	....	....	4.30	....	5.00	5.90	6.30	6.30	....	....	....	7.70
Silverton, Colo.	Durango, Colo.	....	....	1.40	1.40	....	....	2.20	....	....	2.30	2.55	....	2.80	....	2.80
Tyrone, N. M.	Douglas, Ariz.	....	....	1.60	1.90	....	2.20	....	2.50	2.80	....	....	3.40	....	....	3.80
Tyrone, N. M.	El Paso, Tex.	....	....	1.60	1.90	....	2.20	....	2.50	2.80	....	....	3.40	....	....	3.80
Lordsburg, N. M.	Douglas, Ariz.	....	1.00	1.30	1.60	....	1.90	....	2.20	2.50	....	....	2.80	....	....	3.40
Lordsburg, N. M.	El Paso, Tex.	....	1.00	1.30	1.60	....	1.90	....	2.20	2.50	....	....	2.80	....	....	3.40
Tombstone, Ariz.	Douglas, Ariz.	....	....	.60	....	.90	....	....	....	1.30	....	....	1.60	....	....	1.90
Tombstone, Ariz.	El Paso, Tex.	....	....	1.90	....	2.50	....	....	....	3.80	....	....	4.40	....	....	4.40
Silver City, N. M.	Douglas, Ariz.	....	....	2.48	....	3.15	....	....	....	3.83	....	....	....	....	....	5.29
Ray Junction, Ariz.	Hayden, Ariz.	....	.10	....	.40	....	.50	....	.80	.90	....	....	1.00	....	....	1.10
Sandon, B. C. / Alamo Concentrator, B. C.	Tadanac, B. C.	1.50	1.60	1.70	1.90	2.00	2.50	....	2.60	2.90	3.40	3.50	....	3.70	3.80	3.90
Rossland, B. C.	Tadanac, B. C.	.90	.90	1.00	1.00	1.10	1.50	....	1.60	1.60	1.60	1.70	....	1.70	1.70	1.70
Rossland, B. C.	Tadanac, B. C. (*d*)	.30	.30	.30	.30	.50	.70	....	.80	.80	....	....	....	....	....	....
Republic, Wash.	Tadanac, B. C.	....	2.02	2.50	2.66	2.86	3.84	....	3.84	3.84	4.69	4.89	....	5.19	5.39	5.59

(*a*) Minimum tonnage of 200 tons per day. (*b*) In open cars, minimum 80,000 lb. (*c*) Siliceous ore tailing.
(*d*) Applicable on ore, only when shipped in trainload lots of not less than 10 cars and exclusive of switching charges at Rossland.

Rates on Ores and Concentrates

From	To	Value of Ores and Concentrates $10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
		Rate													
Burke, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	....	.68	....	.....	....	....	1.02
Burke and Wallace, Idaho	East Helena, Mont.	....	....	....	....	3.00	....	3.25	3.50	3.75	4.00	.....	4.25	4.50	4.75
Sagel, Idaho	East Helena, Mont.	....	....	....	3.38	....	3.83	....	4.16	....	....	.....	....	.....	4.84
Arizona Tunnel, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	....	.35	....	.....	....	.....	.50
Bayview, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	3.75	....	....	4.37½	....	.....	5.12½
Park City, Utah	Salt Lake Smelters	1.00	1.10	1.25	....	1.50	....	1.75	....	2.00	....	.....	2.25	.....	2.50
Eureka, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Tintic, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
St. Johns, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Ophir, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Bingham, Utah	Garfield, Utah	....	.40	....	.75	....	....	....	.95	....	....	1.10	....	.....	1.25
Cherry Creek, Nev.	Garfield, Utah (*b*)	....	....	4.60	....	5.10	....	5.60	6.10	6.60	7.10	.....	7.60	8.10	8.60
Cherry Creek, Nev.	Garfield, Utah (*b*)	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7 40	....	....
Goldfield, Nev.	Salt Lake Smelters	....	....	5.10	....	5.80	....	6.50	7.20	7.90	8.60	.....	9.30	10.00	10.70
Battle Mountain, Nev. (*a*)	Salt Lake Smelters	....	....	3.20	....	3.80	....	4.40	5.00	5.60	6.20	.....	6.80	7.40	8.00
Palisade, Nev. (*a*)	Salt Lake Smelters	....	....	3.20	....	3.80	....	4.40	5.00	5.60	6.20	.....	6.80	7.40	8.00
Mina, Nev. (*a*)	Salt Lake Smelters	....	....	3.60	....	4.30	....	5.00	5.70	6.40	7.10	.....	7.80	8.50	9.20
Lovelock, Nev. (*a*)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Golconda, Nev. (*a*)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Hazen, Nev. (*a*)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Tonopan, Nev.	Salt Lake Smelters	....	....	5.10	....	5.80	....	6.50	7.20	7.90	8.60	.....	9.30	10.00	10.70
Rogerson, Idaho	Salt Lake Smelters	3.00	....	3.50	....	4.00	....	4.50	5.00	5.50	6.00	.....	6.50	7.00	7.50
Georgetown, Colo.	Leadville, Colo.	....	....	3.50	....	3 75	....	4 00	5.00	5.00	5 80	.....	5.80	5.80	5.80
Shirley, Colo.	Leadville, Colo.	....	....	2.25	....	2.25	....	2.25	2.25	4.30	4.30	.....	4.30	4.30	4.30

(*a*) Minimum weight, marked capacity of car used, but not less than 80,000 lb. (*b*) Minimum weight, 80,000 lb. (*c*) Minimum weight, 40,000 lb.
Indicates a change or tariff since last report.

MINING STOCKS

Week Ended December 8, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	...	...	58	June 23, Q	$1.50
Alaska-Br. Col.	N. Y. Curb	*70	*50	*50	...	...
Allouez	Boston	...	...	*16	Mar. '19	1.00
Anaconda	New York	38⅛	37⅞	38	De. 15, Ja. 21, Q	0.75
Arcadian Consol.	Boston	2⅛	1⅞	2	...	...
Ariz. Com'l	Boston	8¼	7⅛	7⅞	July '23,	0.50
Calaveras	N. Y. Curb	...	...	2⅛	...	...
Calumet & Arizona	Boston	44	42½	43½	De. 7, De. 24, Q	0.50
Cal. & Hecla (New)	Boston	20	19⅛	19⅜	De. 1, De. 17	0.50
Centennial	Boston	...	...	7	Dec. '18, SA	1.00
Cerro de Pasco	New York	43⅛	42⅛	43⅜	Oc. 18, No. 1, Q	1.00
Chile Copper	New York	27⅜	26½	27⅛	De. 1, De. 29, Q	0.62½
Chino	New York	16⅛	16⅛	16⅜	Sept. '20, Q	0.37½
Con. Cop. Min. (New)	N. Y. Curb	1 3/16	1⅛	1 3/16	...	...
Copper Range	Boston	25½	24	24	May '23, Q	1.00
Crystal Copper	Boston Curb	68	63	65	...	...
Davis-Daly	Boston	3⅛	3	3	Mar. '20, Q	0.25
East Butte	Boston	5⅛	5	5	Dec. '19, A	0.50
First National	Boston Curb	28	27	28	Feb. '19, SA	0.15
Franklin	Boston	1¼	*95	1	...	...
Gadsden Copper	Boston Curb	...	...	*43	...	...
Granby Consol.	New York	14⅛	13½	13½	May '19, Q	1.25
Greene-Cananea	New York	15⅛	14⅛	15	Nov. '20, Q	0.50
Hancock	Boston	1⅛	1⅛	1 7/16	...	...
Howe Sound	N. Y. Curb	3	2⅞	3	Ja. 2, Ja 15	0.05
Inspiration Consol.	New York	26½	25⅛	25⅜	De. 20, Ja. 7, Q	0.50
Iron Cap	Boston Curb	4	3½	4	May 23, K	0.15
Isle Royale	Boston	20½	18	18	Se. 1, Se. 15,	0.50
Kennecott	New York	35⅛	34⅛	34½	De. 7, Ja. 2, Q	0.75
Keweenaw	Boston	*90	*85	*85	...	...
Lake Copper	Boston	1⅛	1½	1½	...	...
Magma Copper	New York	30½	30	30½	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	1⅜	1⅜	1⅜	...	...
Mass Consolidated	Boston	1	*99	*99	Nov. '17, Q	1.00
Miami Copper	New York	22	21⅜	22	No. 1, No. 15, Q	0.50
Michigan	Boston	1⅛	1⅛	1⅛	...	...
Mohawk	Boston	*33½	*32⅛	*32⅛	Se. 22, Oc. 13,	1.00
Mother Lode Coa.	New York	9⅛	8⅛	9	De. 14, De. 31	0.50
Nevada Consol.	New York	12⅛	11⅛	12	Sept. '20, Q	0.25
New Cornelia	Boston	*16	*15⅛	*15⅞	Au. 3, Au, 20, Q	0.25
New Dominion	N. Y. Curb	2⅜	2⅛	2⅛	...	...
North Butte	Boston	2⅜	2⅛	2⅛	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*87	*78	*84	...	...
Old Dominion	Boston	17	17	17	Dec. '18, Q	1.00
Osceola	Boston	...	...	31½	June '23, Q	1.00
Phelps Dodge	Open Mar.	†145	†135	....	Se. 20, Oc. 2 Q	1.00
Quincy	Boston	23	22	22	Mar. '20, Q	1.00
Ray Consolidated	New York	12⅛	11⅞	11⅞	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*25	*25	*25	...	...
St. Mary's Min. Ld.	Boston	*33	*32	*32⅞	No. 9, De. 11, K	1.00
Seneca Copper	New York	6¼	5⅛	5⅞	...	...
Shannon	Boston	*42	*35	*42	Nov. '17, Q	0.25
Shattuck Arizona	New York	6⅞	6⅛	6⅛	Jan. '20, Q	0.25
South Lake	Boston	...	...	⅛	...	...
Superior & Boston	Boston	1⅛	1	1⅛	...	...
Tenn. C. & C. cfs.	New York	9	8⅞	9	De. 31, Ja. 15, Q	0.25
Tuolumne	Boston	*50	*40	*50	May '13,	0.10
United Verde Ex.	N. Y. Curb	27	26½	27	Oc. 5, No. 1, Q	1.00
Utah Consol.	Boston	*5	*2	*5	Sept '18,	0.25
Utah Copper	New York	65⅛	63⅞	63⅞	De. 3, De. 15, Q	1.00
Utah Metal & T.	Boston	*26	*25	*26	Dec. '17,	0.30
Victoria	Boston	*85	*75	*75	...	...
Winona	Boston	*15	*15	*15	...	...
Wolverine	Boston	...	...	5⅛	...	...
NICKEL-COPPER						
Internat. Nickel	New York	12⅛	11⅛	12	Mar.' 19,	0.50
Internat. Nickel pfd.	New York	80	79	79	Oc. 11, No. 1 Q.	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	2	2	2	...	...
National Lead	New York	127⅞	124⅝	127½	De. 14, De. 31, Q	2.00
National Lead pfd.	New York	111	110⅜	110⅜	Au. 24, Se. 15 Q	1.75
St. Joseph Lead	New York	23	21⅛	22⅛	Se. 9, Se. 20 Q, X	0.50
ZINC						
Am. Z. L. & S.	New York	8⅛	7⅛	7⅛	May '20,	1.00
Am. Z. L. & S. pfd.	New York	...	...	30	Nov. '20, Q	1.50
Butte C. & Z.	New York	5⅜	5⅛	5⅛	Mar. '23,	0.50
Butte & Superior	New York	16	15⅛	15⅛	Je. 15, Je. 30, Q	0.50
Callahan Zn-Ld.	New York	5	4⅜	4⅜	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	151	150	151	Oc. 31, No. 10, Q	2.00
United Zinc	N. Y. Curb	...	...	*50	...	...
Yellow Pine	Los Angeles	...	...	*70	June '23, Q	0.03
SILVER						
Alvarado	N. Y. Curb	1⅜	1⅜	1⅜	...	...
Batopilas Mining	New York	¼	¼	¼	Dec, '07, I	0.12½
Beaver Consol.	Toronto	*26	*25	*25	May '20, K	0.03
Candelaria	N. Y. Curb	*3	*2	*2	...	...
Castle-Trethewey	Toronto	*44¼	*44	*44	...	...
Conigas	Toronto	3.40	3.20	3.40	Oc. 19, No. 1, '23	0.02½
Crown Reserve	Toronto	*69½	*68¼	*69	Jan. 17,	0.05
Kerr Lake	N. Y. Curb	2½	2	2	Oc. 1, Oc. 15, Q	0.12½
La Rose	Toronto	...	...	*24	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*14½	*13½	*14	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	3.20	3.06	3.12	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6½	6⅛	6½	Ja. 1, Ja. 21, QX	0.30
Ontario Silver	New York	6	5	6	Jan. '19, Q	0.50
Temiskaming	Toronto	*33½	*32	*32½	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅛	⅛	⅛	...	....
Alaska Juneau	New York	1⅛	⅛	1	...	....
Boundary Red M.	N. Y. Curb	...	...	*12	...	....
Carson Hill	Boston	3	2	2⅛	...	....
Cresson Consol. G.	N. Y. Curb	3⅛	3 3/16	3⅛	Se. 30, Oc. 10, Q	0.10
Dome Mines	New York	19⅝	19⅜	19½	De. 31, Ja. 2, Q	0.50
Golden Cycle	Colo. Springs	1.07	1.05	1.07	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	11.55	11.50	11.50	De. 13, Ja. 3, M	0.05
Homestake Mining	New York	59½	57	58	De. 20, De. 26 M	0.50
Kirkland Lake	Toronto	*31½	*30	*30	...	...
Lake Shore	Toronto	3.46	3.44	3.45	No. 1, No. 15'23	Q 0.02
McIntyre-Porcupine	New York	18½	17⅜	18½	De. 1, Ja. 2,	0.25
Portland	Colo. Springs	*45	*44½	*44½	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1 3/16	1⅛	1 3/16	...	...
Tom Reed	Los Angeles	...	...	*57½	Dec. '19,	0.02
United Eastern	N. Y. Curb	1⅛	*95	1 1/16	Oc. 8, Oc. 28, Q	0.15
Vipond Cons.	Toronto	*96	*92½	*95	...	...
Wright-Hargreaves	Toronto	3.25	3.10	3.15	Se. 15, Oc. 1, Q	0.02½
Yukon Gold	N. Y. Curb	*80	*65	*75	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*21	*15	*18	...	....
Con. Cortez	N. Y. Curb	*54	*50	*54	...	....
Con. Virginia	San Francisco	7⅛	6⅛	6⅛	...	....
Continental Mines	N. Y. Curb	4⅝	4⅝	4⅝	...	....
Dolores Esperanza	N. Y. Curb	85	*70	*75	Jy. 1, Jy. 10 Q	0.05
Jib Consol	N. Y. Curb	...	...	*65	...	...
Tonopah Belmont	N. Y. Curb	...	...	*38	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*41	*39	*40	Se. 22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	1 1/16	1⅛	1 1/16	De. 11, Ja. 1	0.05
Tonopah Mining	N. Y. Curb	1⅛	1⅛	1 1/16	Se. 30, Oc. 1	0.07½
Unity Gold	N. Y. Curb	2⅛	1⅝	2⅛	...	...
West End Consol.	N. Y. Curb	*60	*60	*60	Mar. '23, Q	0.05
SILVER-LEAD						
Ahumada	Boston Curb	5¼	5	5¼	De. 15, Ja. 2, X	0.10
Bingham Mines	Boston	16	16	16	Sept. 19, Q	0.25
Cardiff M. & M.	Salt Lake	98	95	97	Dec. '20,	0.15
Chief Consol.	Boston Curb	3⅛	3⅛	3⅛	Oc. 10, No. 1, Q	0.10
Columbus Rexall	Salt Lake	*28	*25	*27	Aug. '22,	0.03
Consol. M. & S.	Montreal	28	26½	27½	Oct. '20, Q	0.62½
Erupcion	Boston Curb	1⅜	1⅛	1⅜	De. 15, Ja. 2, X	0.125
Federal M. & S.	New York	...	...	11¼	Jan., '09,	1.50
Federal M. & S. pfd.	New York	42½	42	42	No. 26, De. 15,	1.75
Florence Silver	Spokane	*13½	*13	*13	Apr. '19, Q, X	0.01
Hecla Mining	N. Y. Curb	8⅛	8⅛	8⅛	Au. 15, Se. 15	0.15½
Iron Blossom Con.	N. Y. Curb	*34	*31	*31	Oct. 25, '23,	0.02
Marsh Mines	N. Y. Curb	*9	*8	*9	June '21, I	0.02½
Park City	Salt Lake	....	....	4.00	Se. 15, Oc. 1 Q	0.12
Park Utah	N. Y. Curb	....	....	3	Ja. 1, Q	0.15
Prince Consol.	Salt Lake	...	...	*75	Nov. '17,	0.02
Silversmith	Spokane	*31	*30	*30	Oc. 1, Oc. 10	0.01
Simon Silver-Lead	N. Y. Curb	*2	*1	*1	...	....
Snowstorm Silver-L.	N. Y. Curb	...	...	*46	...	....
Tamarack-Custer	Spokane	1.38	1.35	1.36	Se. 30, Oc. 1, K	0.02
Tintic Standard	Salt Lake	3.90	3.75	3.90	Se. 24, Se. 29	0.15
Utah-Apex	Boston	2⅜	2⅛	2⅛	June '23, Q, X	0.50
IRON						
Bethlehem Steel	New York	54½	52⅛	53⅛	De. 1, Ja. 2, Q	1.25
Char. Iron	Detroit	⅜	⅜	⅜	...	....
Char. Iron pfd.	Detroit	1⅛	1⅛	1⅛	...	....
Colorado Fuel & Iron	New York	24⅛	22⅞	23⅛	No. 10, No. 26 Q	2.00
Col. Fuel & Iron pfd.	New York	...	...	102	Feb. '23, Q	2.00
Gt. North'n Iron Ore	New York	32⅛	32	32⅛	Apr. '23	1.00
Inland Steel	N. Y. Curb	...	...	46	No. 15, De. 1Q	0.62½
Mesabi Iron	N. Y. Curb	...	...	5	...	....
Replogle Steel	New York	13⅛	12⅛	12½	...	...
Republic I. & S.	New York	49⅞	47⅞	48⅝	May '21	1.50
Republic I. S. pfd.	New York	92⅝	92	92	De. 15, Ja. 2 Q	1.75
Sloss-Sheffield S. & I.	New York	54⅛	52⅞	54⅛	Feb. '21,	1.50
Sloss-Shef. S. & I. pfd.	New York	81	81	81	De. 20, Ja. 2, Q	1.75
U. S. Steel	New York	95⅞	94⅛	94⅜	No. 29, De. 29, Q	1.50
U. S. Steel pfd.	New York	119	118⅝	119	No. 4, No. 28, Q	1.75
Virginia I. C. & C.	New York	...	...	52	De. 15, Ja. 2	1.50
Virginia I.C.&C.pfd.	New York	...	...	83	De. 15, Ja. 22	2.50
VANADIUM						
Vanadium Corp.	New York	31⅛	29⅞	30½	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	35	34½	34½	Se. 29, Oc. 15 Q	1.00
Asbestos Corp. pfd.	Montreal	63	61½	61½	Se. 29, Oc. 15 Q	1.50
SULPHUR						
Freeport Texas	New York	13⅞	12⅝	13	Nov. '19, Q	1.00
Texas Gulf	New York	60½	59	60	De. 1, De. 15 Q X	2.00
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3⅛	3⅛	3⅛	...	....
MINING, SMELTING AND REFINING						
Amer. Metal	New York	44⅛	43	43	No. 17, De. 1, Q	0.75
Amer. Metal pfd.	New York	...	...	110	No. 19, De 1, Q	1.75
Amer. Sm. & Ref.	New York	59⅞	58⅛	58⅞	Oc. 11, No. 1, Q	1.25
Amer. Sm. & Ref. pfd	New York	96	95½	95⅞	No. 9, De. 1	1.75
U. S. Sm. R. & M.	New York	23	21½	22⅛	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	41	40⅛	40⅛	Oc. 8, Oc. 15, Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

NEW MACHINERY AND INVENTIONS

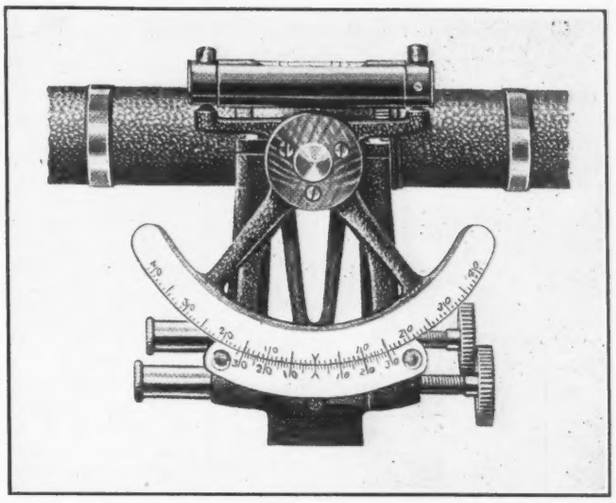
Plane Table Alidade Redesigned

New Instrument Intended for High Class of Work in Topography

The latest Berger plane table model embodies the results obtained by completely redesigning the entire external and internal construction of the different patterns which support the various graduated arcs and the attachments which go to make up this instrument. The general basic principles for this type of instrument are, of course, still to be found.

At a great expense the company has changed over all patterns, which formerly consisted of a flimsy cross-section, to a cross-section possessing greater rigidity and strength with lightness combined, and which is by far more agreeable to the eye, as well as to the hand, thus bringing this type of instrument closer to the construction lines found on the company's other instruments.

The alidade is built strong and light. The ruler and other parts are of bronze. The telescope's axis is of hard bell metal. The telescope is well lighted, powerful, and of greater length than usual, the latter enabling the observer to sight readily at an object when the alidade is some distance from the edge of the board. The telescope's outer barrel is bored out cylindrically, end for end, and at right angles to the trunnions of the telescope's axis. The telescope's focusing slide is ground into its outer barrel. Thus, it will readily be seen that the slide receives the full benefit of its bearing for its entire length, and, being fitted with great care, is perfect for any and all distances. The telescope may be had either erecting, or inverting, the inverting kind being usually furnished with these instruments. The ruler is provided with a circular spirit level, and is so arranged that lines can be ruled in the vertical plane of the telescope, if desired. To obtain great rigidity and strength, the diameter of the bearing surface of the Berger lower motion in both sizes is larger than usual, and the board rests on radial arms extending considerably beyond this bearing surface. The tripod head is of corresponding size. To be portable all the essential parts are built on the skeleton plan. This head is of composition brass, and to prevent all wabbling of the leveling screws when worn, these latter are also provided with check nuts. Materials and workmanship are of the quality characteristic of the maker.



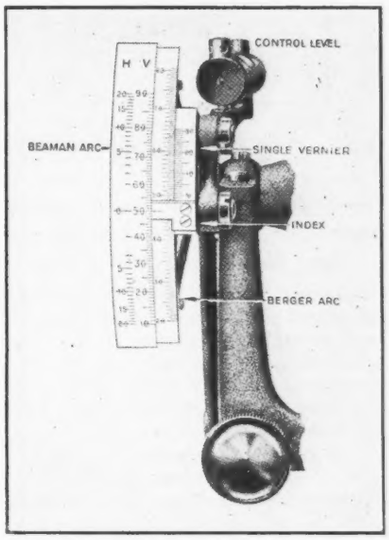
This 4½-in. vertical arc has face graduations with double verniers reading to minutes

The U-shaped frame which supports the telescope is considerably wider and more massive than formerly made and permits of less cramping of parts such as the telescope's clamp. The arcs, of which cuts are shown, with their respective verniers, are all on the outside of this U-shaped frame and are thus far more easily read and more accessible than if attached to the telescope's axis within the confines of the U frame. This the company believes is important.

There is nothing flimsy about the design of the patterns which support their respective arcs and verniers, and they are constructed with a single purpose in view—namely, greater rigidity and greater strength.

The micrometer may be made so that it is interchangeable with the regular inverting eye-piece, if provision has been made to receive it. The U standard and the ruler is strongly trussed and ribbed. The metal in these latter parts has been redistributed to gain greater strength without excess of material.

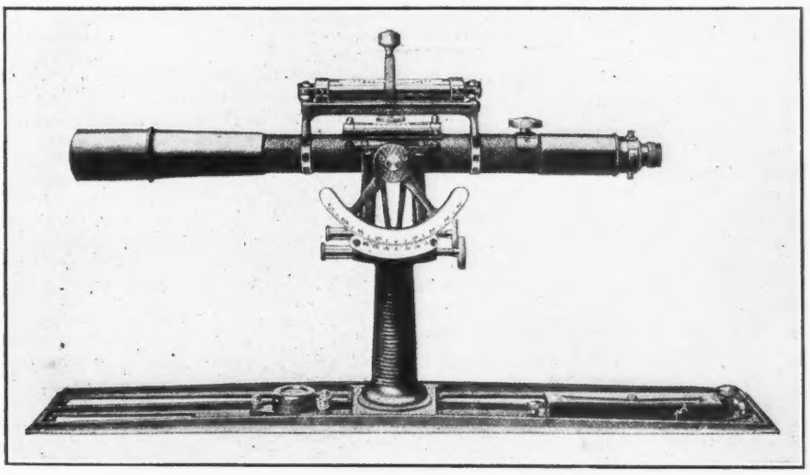
The box level mounted on the ruler now takes the place of the two levels which were formerly mounted at right angles to each other. This circular level, with its superior adjustments, is not to be confused with the cheap box level, as applied to cameras, as it is unusually well made.



Beaman 4⅝-in. stadia arc has an edge graduation with a single vernier reading to minutes

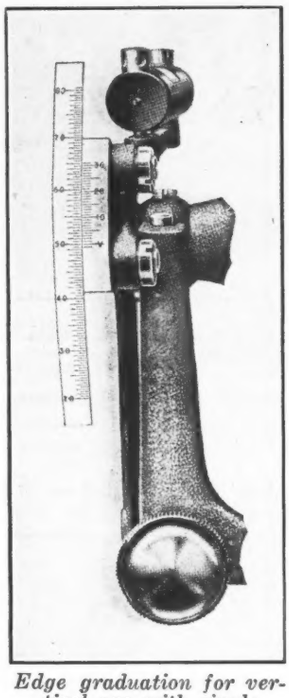
This plane table is made as carefully as the company's standard engineering instruments, the company holding the opinion that it will be used more and more for some kinds of engineering for which the transit is now regularly used.

The ruler is nickel plated underneath, so that it will not soil the drawing paper. Spray-lacquering and lacquering of any other nature is likely to chip or wear off, which causes an unsightly appearance when viewed from beneath.



Strength and lightness, together with attractive lines, have been obtained in this new model of plane table alidade

The compass box is water-tight and may be detached from the ruler. The Berger lower motion with tangent screw and with opposing plunger, which contains a spring, now takes the place of the old-time ball-and-socket arrangement, with its slow-motion tangent screw.



Edge graduation for vertical arc with single vernier reading to minutes

One-Man Excavator Useful for Clay, Sand, and Gravel Pits

Intended primarily for small sand and gravel pits where the output is not large enough to warrant an expensive installation, a one-man loading and excavating machine made by the Bay City Dredge Works, Bay City, Mich., has interesting features. The power for operating the loader is furnished by a 12-hp. gasoline engine, but is so arranged that it can be equipped with a 15-hp. electric motor. All the operating levers are handled by one man and are placed well forward and to the right of the mast, so that the operator has an unobstructed view of his work at all times. The hoisting, backing, and swinging and propelling mechanisms are operated by friction clutches which actuate the drums directly. A suitable lowering and sustaining brake for the dipper is controlled by a foot lever.

The machine is mounted on four double-flanged wheels running on sectional track. It is moved ahead by a cable device with a hook operating from a drum and attached to the track. In this way it is possible for the machine to move up to new work under its own power.

A Michigan gravel pit operator claims that the cost is 1½c. per cubic yard for gas, oil, and labor and that the machine can load one cubic yard a minute.

Device Gives Warning of Fire

A small device which can be applied in mine fire warning or protective systems has been developed by a Chicago manufacturer. The particularly interesting feature of this device is that it may be used to cover only one single danger point in a mine or mine structure or as many as may be desired for protection. It is not limited as to the distances or the sizes of the alarm bell, and in its installation use is made of simple bell wiring, with ordinary bells and batteries or transformers, and it is wired in the same manner as a house bell.

The manufacturer guarantees the device for five years and its construction of heavy cast brass, with two binding posts, makes it dirt and dust as well as moisture proof and unaffected by gases. Instantaneously automatic, the contacts of the device close when the temperature reaches the danger point at which the instrument is set. This danger point is usually 110 deg. F. For adjusting for various temperatures an adjusting screw is used and one quarter turn changes the heat adjustment 15 deg. By holding a lighted match near the detector the device can be tested from time to time.

The fact that individual detectors may be used to guard against undetected fires in unfrequented parts of a plant is a particularly valuable feature. Many times disastrous fires originate in out-of-the-way corners where there is no necessity of the frequent or constant presence of employees. This device is manufactured by Bennett & Co., 112 W. Adams St., Chicago, Ill.

INDUSTRIAL NOTES

Eagle-Picher Sales Conference a Notable Affair

The annual sales conference of the Eagle-Picher Lead Co. on Dec. 10, 11 and 12 was a matter of importance to the Joplin-Miami district. Officers of the company, sales managers, branch office managers, technical salesmen, and operating officials were in attendance. Monday was devoted to inspection of the Eagle-Picher mining properties in the Oklahoma district, under the guidance of A. E. Bendelari, vice-president in charge of mines. Tuesday morning was spent going over the Joplin plant, the largest lead-manufacturing plant of its kind in the world. A meeting was held in the research laboratory on Tuesday afternoon, and there was a dinner at the Connor Hotel in Joplin Tuesday night. The meeting on Wednesday was marked by the presentation of several papers. Thursday was spent in visiting the company's two plants at St. Louis, and on Friday the company's smelter at Hillsboro was visited.

The Eagle-Picher company, which was the pioneer in opening up the Picher section of the Oklahoma zinc and lead field, is one of the largest operating companies in the zinc and lead industry. In addition to its holdings of mining lands it has manufacturing plants at Joplin, East St. Louis, Cincinnati, Newark, N. J., and Argo, Ill., with lead smelters at Hockerville, Okla., Galena, Kan., and Joplin, and zinc smelters at Henryetta, Okla., and Hillsboro, Ill.

Among the leading officials of the company attending the Joplin conference were Thomas S. Brown, Jr., vice-president and treasurer; Dr. J. A. Schaeffer, vice-president and chief chemist in charge of operation of manufacturing plants, and Joseph Hummel, Jr., secretary.

Westinghouse and Japanese Organize New Company

An arrangement between Westinghouse and Japanese electrical interests for the formation of a Japanese electrical manufacturing company has been effected. The new company is known as the Mitsubishi Denki Kabushiki Kaisha, or, in English, the Mitsubishi Electric Manufacturing Co., according to E. D. Kilburn, vice-president and general manager of the Westinghouse International. The capitalization is reported to be 15,000,000 yen, or $7,500,000. The announcement says:

"The Westinghouse company has for many years been engaged in promoting the use of electricity in Japan, and its efforts have met with so favorable a reception that Japanese electrical development, including railroad electrification, the use of water power, the installation of large steam generating plants, and the formation of superpower systems, compares favorably with that in the United States.

"As a consequence of this rapid development, electrical apparatus has become one of Japan's largest imports, and since Japan's principal exports, silk, copper, and objects of art, cannot be expanded by a corresponding degree, the Japanese began to feel that there was danger of a continuing unfavorable balance of trade. Hence it seemed wise to Japanese interests to begin the manufacture of electrical machinery and supplies. The important Mitsubishi interests therefore approached the Westinghouse Electric company with a proposal for a co-operative agreement whereby the Westinghouse company was to supply technical skill and experience to a Japanese manufacturing company.

"The Mitsubishi Electric Manufacturing Co. is the result. The Japanese profit because of the employment it will give to Japanese workmen and the improvement in their foreign trade situation, and the Westinghouse company profits by receiving a continuous revenue for service and royalties in lieu of exports that it was certain to lose within a comparatively few years. The United States profits because if the Westinghouse company had not accepted this proposal, a German firm might have been considered by the Mitsubishi organization.

"A third party to this agreement is Takata & Co., Japanese importers, 30 Church St., New York. This concern, will act as distributor for the Mitsubishi company.